ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVIII., No. 3.

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A 35-FT. ENTRANCE TO NEW YORK HARBOR is strongly advocated by the Chamber of Commerce and the transatlantic and even coastwise steamship lines. The River and Harbor act of June 3, 1896, directed the Secretary of War to ascertain the location and cost of obtaining a depth of 35 ft. at low-water mark from the "Narrows to the sea," and a report upon this head was submitted in January of 1897 by Col. G. L. Gillespie, Corps of Engineers, U. S. A., and an abstract of this report was given at that time in this journal. A resurvey has now been ordered, and the work is being carried on under Lt.-Col. Wm. Ludlow, Corps of Engineers, U. S. A., the successor of Col. Gillespie. Lt.-Col. Ludlow says that it is not proposed, as reported in the press, to deepen the Coney Island channel to 35 ft., though that channel may be deepened to 16 ft. to better accommodate coastwise and excursion steamers. The actual work to be performed cannot be reported upon until the present surveys are completed, and all locations, plans and estimates of cost given in the press accounts are premature and unfounded.

THE SEATTLE & LAKE WASHINGTON WATERWAY Company has stopped paying for the dredging of a channel across the Seattle tide flats, says the Tacoma Ledger," and the Bowers Dredging Company, being out about $50,000, has asked for the appointment of a receiver. The Seattle & Lake Washington Company says that the St. Louis syndicate, which had arranged to buy the state certificates and furnish the money needed, had stopped payment and caused all the trouble. The Seattle & Lake Washington Company was organized several years ago by ex-Governor Semple to construct a canal to the lake, and the plan necessitated cutting through a high bluff. The work actually done by the Bowers Company comprised the dredging of the east waterway for about 2,500 ft. in length and the excavation of about 1,300,000 cu. yds. of material, which was used in filling about 100 acres of Seattle tide flats to a depth of 15 to 20 ft.

A TEXAS WATERWAYS CONVENTION is called for by the Governor of that state to meet at Rockport on Aug. 25, 26. The purpose is to devise ways and means for opening up to continuous navigation the chain of bays extending along the Gulf coast of the state, from the mouth of the Rio Grande to Sabine Pass. For more than two-thirds of this line, it is claimed, dredging alone is required to provide deeper channels. But from Matagorda to Galveston bays a canal would have to be excavated over an easy line.

THE MISSISSIPPI RIVER COMMISSION held its annual meeting in New York early this month, with the purpose of preparing for Congress an estimate for the distribution of money to the various districts. This commission is now made up of Col. G. L. Gillespie, Lt.-Col. Amos Stickney and Major T. H. Handbury, all of the Engineer Corps, U. S. A.; Henry L. Marinden, of the U. S. Coast Survey; B. M. Harrod, President, and Henry Flad, Past President of the American Society of Civil Engineers, and Judge R. S. Taylor, of Fort Wayne, Ind. The commission still advises the contraction of the river channel to 3,000 ft. in width, by the building of low dikes, extending from the shores, and the result of the experiments made at Lake Providence and Plum Point, about 15 years ago, seem to warrant the conclusion arrived at, though the failure of appropriations prevented the completion of the work at these points. Last year the commission made some estimates of the probable cost of the revetment of the river banks. Earlier experiments put the cost at $12 per linear foot; but they now estimate that it will cost $30, or about $150,000 per mile. Though the river is 950 miles long between Cairo and New Orleans, and two banks must be considered, the commission believes that not over 600 miles of the river will need revetment, and that the total cost will be somewhere between $63,000,000 and $100,000,000, and that the maintenance of the work will cost 10% additional. The execution of this work would probably extend over 40 years, as the present available annual supply of material for wicker mattresses is only sufficient for the construction of 15 miles. The chief purpose of levee construction is now admitted to be the protection of the population and the agricultural interests, and, of late years, from one-half to three-fifths of the $2,000,000 or $3,000,000 annually expended by the commission is devoted to this purpose. The states of Missouri, Arkansas, Tennessee, Mississippi and Louisiana have expended large sums in levee building and maintenance in the last 50 years, and in combination with the national government about $35,000,000 has been spent upon these works. Last year the commission estimated that $18,000,000 was needed to complete the system. By cutting off outlets a larger proportion of the river i snow kept between the banks, and the highest flood level of this year was 5 ft., in places, above the floods of the last 20 years. With all contemplated improvements completed it is estimated that the maximum flood level will be 3 ft. higher than it was this year, and this raising of flood level must be provided for in the levee construction.

THE MONONGAHELA RIVER is now thrown open to free navigation, the U. S. government having extinguished the rights to toll of the Monongahela Navigation Company by condemnation proceedings and the payment of $3,761,615 to the company.

THE MOST SERIOUS RAILWAY ACCIDENT of the week is reported from Boone, Ia., July 13. A meat train on the Chicago & Northwestern R. R. ran into several derailed cars, killing eight tramps and injuring several trainmen.

A SERIOUS DERAILMENT of a freight train occurred on the Pittsburg & Lake Erie R. R., at Fallston, Pa., July 7. A broken flange is stated to have been the cause of the accident. The train went down an embankment and killed one and injured three tramps who were stealing rides.

THE BURSTING OF A RESERVOIR LOCATED about one mile from Fishkill, N. Y., is reported just as we go to press. From the somewhat confusing accounts given by the press dispatches the reservoir appears to have been one (some dispatches say two) belonging to the water-works system of the Fishkill & Matteawan Water Co., which supplies the towns of Fishkill and Matteawan, N. Y., with water, and was one or both of the two smaller reservoirs of the system known as Melzingah reservoirs No. 1 and No. 2. According to the Manual of American Water-Works for 1897, the Melzingah reservoirs are located about 800 ft. above the level of the Hudson River, and have capacities of 8,000,000 gallons and 10,000,000 gallons, respectively. The accident happened about 2 a. m., July 14. The released waters followed a small stream, which is the natural course of the overflow from the reservoir, and the chief damage was done to brick yards located along the stream, and to the boarding houses and buildings connected with them, and to the tracks of the New York Central & Hudson River R. R., about 200 ft. of which were washed away. The latest dispatches state that seven persons who lived in the brick yards boarding houses were drowned.

A SERIOUS REAR END COLLISION is reported from Gjentofte, Denmark, which resulted in the death of 38 persons and the injury of 84 others. An error in reading the signals and the failure of brakes are given as the causes.

AN ELECTRIC CAR PLUNGED INTO an open draw bridge about two miles south of Bay City, Mich., on the line between that place and Saginaw, on July 7. The responsibility of the accident is stated to have been due to the motorman, who was racing with a railway train and was unable to stop his car in time to prevent the accident. Seven passengers went into the river with the car, and a woman and three children were drowned.

THE BURSTING OF A 10-TON FLY-WHEEL in the power-house of the Tacoma Street R. R., Tacoma, Wash., July 11, did considerable damage. The accident was caused by the breaking of a rod connected with the governor, which became useless and allowed the engine to race.

A SMALL DAM BURST near Ward, Jefferson Co., Colo., about July 9, according to press reports, doing some damage to property and causing the loss of two lives. The dam belonged to the Left Hand Ditch Co.

THE INJUNCTION AGAINST BUILDING DAM across the Rio Grande River, near Los Vegas, N. M., has been dissolved by the U. S. Circuit Court. The court holds that the effect of the dam would not violate the treaty between the United States and Mexico; that the stream in New Mexico is not a navigable river; that the control of the stream is vested in the territory and not in Congress; and that cause for an injunction does not exist, because the navigable capacity of the river at a distance below might be diminished by a dam.

COMPULSORY CONNECTION OF BUILDINGS with water and gas mains, sanitary and storm sewers, before improving two streets in Montgomery, Ala., is required by an ordinance of recent date. The ordinance passed the city council by a vote of 14 to 0, the indications being that this is a common requirement in that city. Mr. C. P. Hardaway is City Clerk of Montgomery.

A CHEMICAL AND BIOLOGICAL LABORATORY for the Brooklyn water supply is now being established, and Mr. Geo. C. Whipple has been selected as biologist. A chemist is to be appointed later. The laboratory will form a part of the Department of Public Works. We are indebted to Mr. I. M. de Varona, M. Am. Soc. C. E., Engineer of Water Supply, for the above information.

THE JERSEY CITY WATER SUPPLY matter is likely to come to the front again soon, Mr. Garwood Ferris, of Jersey City, having been selected by the Street and Water Commissioners as its engineer for a new supply and Mr. C. C. Vermeule by the Board of Finance. It is expected that new specifications will be prepared and bids invited for a supply.

THE WATER HYACINTH, which was imported into Florida from Venezuela some years ago and was seriously impeding navigation in the St. Johns River, is being killed by a small red spider. This spider is said to be also an importation from Venezuela and is known as a deadly enemy to water growth of this character. At Palatka thousands of acres of water front were covered with this thick aquatic vegetation and the situation was becoming so serious that a State commissioner had been appointed to officially report upon means for its destruction. It is now believed that the red spider will clear the river of the nuisance in one or two years.

A MILITARY POST at Bahia Blanca, Argentine, is to be constructed and proposals are asked for by Senor L. Luiggi, Ingeniero, Director-General des las Obras del Puerto Militar, Buenos Aires, Argentina. There are two projects, a lesser and a complete project. Approximate quantities for some of the larger items in the two projects stand as follows:

	Lesser.	Complete.
Dredging excavation, cu. m.....	3,000,000	4,500,000
Excavation, on dry land, cu. m.....	150,000	300,000
Earth for quay, cu. m.	250,000	300,000
Dry stone paved faces, cu. m.....	25,000	30,000
Granite for face work, cu. m.	10,000	15,000
Concrete, cu. m.	80,000	120,000
Pressed brick walls, cu. m.....	6,000	15,000
Cut granite, cu. m.	4,000	7,000
W't iron in lock-gates, etc., m. tons	800	1,200
Cast-iron work, m. tons	300	500
Macadam for streets, cu. m.	6,000	6,000
Granite paving blocks, cu. m.....	4,000	7,000
Dry dock machin'y,pumps,etc.,HP.	500	600
Hydraulic machinery, HP.....	700	1,000
Building masonry, cu. m.	5,000	10,000

The profit allowed by the government in the estimates is 20%. Senor Luiggi understands English perfectly and can be addressed as above. No time is given for the submission of proposals.

THE STEEL COUNTRY ROADS, with which the U. S. Department of Agriculture is now experimenting, will practically be constructed as follows: The present design calls for an inverted trough-shaped steel rail, with a slightly raised bead on the inside, and 8-in. tread and 7-16 in. thick. These rails would be bedded in gravel laid in well-drained trenches, and the rails would be tied together at the ends and at the middle. On grades the rails would be indented slightly to prevent the horses slipping on the rails; the joints would be made stronger than the rail to prevent "low joints," and to prevent the formation of ruts alongside the rails each joint would form a "remount" for the wheels. The advantage claimed for these steel roads is the reduction in traction from 40 lbs. per ton on Macadam to 8 lbs. on the steel rails. The materials for the heavier class of steel roads of this design will cost about $3,500 per mile in small quantities. The amount of material required is less than 100 tons per mile, and long lines could probably be built for $2,000 per mile. The lighter type of road only requires 50 tons per mile and would cost about $1,000 per mile. These prices are exclusive of grading and track laying.

SUBMERGED WOODEN PIPE FOR THE RIO GRANDE DAM & IRRIGATION CO.

By J. L. Campbell.*

The Rio Grande Dam & Irrigation Co., with headquarters at El Paso, Tex., is engaged in the construction of irrigation works in the Rio Grande Valley.

The canal now under construction is 34 ft. wide on the bed and carries 5 ft. of water. Its grade is 1 in 5,000, its sectional area 207.5 sq. ft., and its hydraulic mean radius is 4. Kutter's formula, with "n" taken to be 0.025, gives a velocity of 2.15 ft. per sec. and a discharge of 446 sec. ft.

Of special interest is the crossing of this canal under the bed of the Rio Grande in four inverted siphons of 50-in. wood stave pipes. Fig. 2 gives the details of this crossing, and Figs. 3 and 4 are reproduced from views taken during its construction. The canal grade was too low to pass over the river. For the case in hand the method adopted possessed other advantages. Wood pipes constantly submerged and saturated by water are much more durable than flumes.

The work was begun in January, 1897. On Feb. 18 the contractor declined further to assume responsibility for the construction. The writer thereafter personally directed the work for the company, the contractor supplying labor and material as required.

The first thing accomplished after Feb. 18 was the diversion of the river around the site of the crossing by a temporary channel and dam. Reference to the accompanying map of location of the canal crossing (Fig. 1) will show the relative positions of the crossing, the temporary dam and the temporary channel. The latter was cut across low ground lying between the river and the high river bank on the east. It was excavated 20 ft. wide on the bed to a depth sufficient to let 6 ins. of water run through from the river at the upper end. Being in sand, this channel rapidly widened and deepened as the construction of the dam forced the water into it, until it finally carried the entire flow. During construction the river rose and the new channel became 150 ft. wide and 4 to 5 ft. deep.

The temporary dam was built of 2-bushel sand bags, of which 7,000 were used. The bed of the river is a semi-quicksand, and to prevent scour the sand-bag dam was built on a light willow mattress. Quite a bit of filtration occurred through the mattress, but dumping sand against the upper side of the dam finally stopped it. The dam was then widened and raised by dumping upon it the material from the excavation for the pipes. The river was carrying about 500 sec. ft. of water when the dam was closed.

From the east bulkhead of the crossing and east end of the temporary dam the north bank of the canal was built ahead to the west bank of the temporary channel. The outside slope of this bank was protected by a substantial willow mattress, shown by the view (Fig. 5).

*Chief Engineer of the Rio Grande Dam & Irrigation Co., El Paso, Tex.

With this work done, the construction of the pipe lines and bulkheads progressed securely and was completed on April 22. The excavation for the pipes was 25 ft. wide on the bottom, and where no cribbing was used was about 100 ft. wide at the level of the bed of the river. It was from 7 to 12 ft. deep, the whole of it being in sand, quicksand and water. On the east half of the excavation, cribbing was driven of 2×12-in. stuff, braced against the outside rows of anchor piles for the pipes for the purpose of keeping the sand from running. The result was not satisfactory. On the west half no cribbing was used and the excavation was much expedited by the free use of scrapers, the manipulation of which had been much hampered by the cribbing at the other end. The slopes of the sand were from 4 on 1 to 5 on 1 when fairly wet. Two centrifugal pumps, one No. 6 and one No. 8, kept the water down to the bottom of the pit. They ran day and night. They lifted large quantities of sand, and the No. 8 pump completed the excavation of the east half of the pit where cribbing was used.

There are 1,552 lin. ft. of 50-in. wood pipe of selected Texas yellow pine, with ½-in. steel bands, 1 ft. c. to c. There are 75 anchor piles for the pipes, driven so that their tops are 3 ft. below the bed of river, and 66 piles in the bulkheads. The piles are from 20 to 26 ft. long. They were all driven by a drop hammer, operated by two teams of horses. A steam hammer with lighter but rapid blows would have given much better progress. All wood and timber work, including the building of the pipes, was done by ordinary carpenters and bridge men, without experience on similar work.

When the pipes were complete the filling around the bulkheads was made and the willow mattress was built in place, as shown in Fig. 2. The pumps were then removed, after the pipes had been filled with water, and the latter then filled the pit to a level 6 ft. above the top of the pipes. The dam was next cut in the middle.

The sand bags washed out slowly, the pit gradually filled with sand and the river channel has resumed its normal condition over the pipes. During construction the river rose 3 ft. and the temporary channel still carries a large volume of water. After the river was turned back into the regular channel, the river reached high-water mark on May 9. It is now receding. The work has not been damaged to date.

In July and August the river ceases flowing, or carries a very small stream. The temporary channel will then be closed.

FIG 3.—VIEW FROM WEST END.

FIG. 4.—VIEW FROM EAST END.

FIGS. 3 AND 4.—SUBMERGED WOODEN PIPES ACROSS THE RIO GRANDE RIVER.

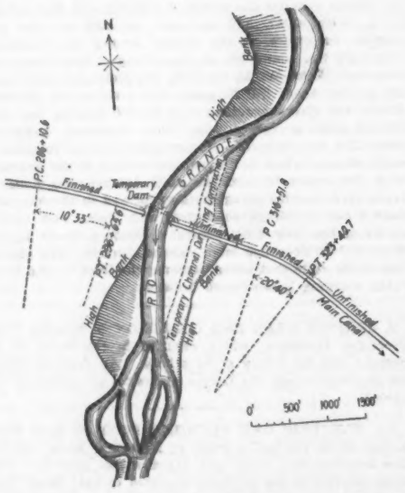


Fig. 1.—Location of River Crossing, Temporary Dam and Channel.

The discharge of the canal has been given as 446 sec. ft. The combined sectional area of the pipes is 54.54 sq. ft., requiring a velocity of 8.18 ft. per sec. to pass the full supply of the canal. The velocity requires a head of 1.04 ft. The entry head will be one-half of that, or 0.52 ft. The required slope to maintain the velocity in the pipes is found by solving for the value of S in Kutter's formula, $V = C\sqrt{RS}$, in which the values of V, C and R are known. S is found equal to 0.00264, and since the crossing is 388 ft. long, the total fall is 1.02 ft.

We have then for total difference in levels of water at opposite ends of the crossing, the velocity head = 1.04, the entry head = 0.52, and the slope = 1.02 ft., a total of 2.58 ft. The actual difference, as shown on the plan, is 3.06, and with that head the pipes will discharge about 485 sec. ft. at a velocity of 8.9 ft. per sec. For the smooth surface of wood pipe "n" in Kutter's formula was taken equal to 0.01. The entry ends of the pipes were belled out to 56 ins. diameter. This will somewhat increase the capacity.

The work now begun, one feature of which has been described, is the inauguration of a comprehensive system of irrigation which, if completed, will supply water to 300,000 acres of land in the Rio Grande Valley in Southern New Mexico, Texas and Mexico. The salient features of the enterprise will be the storing of the flood waters behind a large dam across the Rio Grande at Elephant Butte, 112 miles above El Paso, the gradual delivery of the water therefrom through the river channel and its diversion at proper points by subsidiary dams or weirs. One of these weirs we are now building, but work is temporarily suspended on account of high water. We hope to be able to begin work on the Elephant Butte dam after the flood season is past. This has now become an international question by reason of the claim of Mexico that we will obstruct a navigable stream if said dam is built. I see this is mentioned in Engineering News of May 13. The Attorney-General of the United States, however, has only issued instructions to W. B. Childers, United States Attorney for New Mexico, to enjoin the construction of the dam. No criminal proceedings have or will be instituted. The case will come up for hearing at Silver City,

N. Mex., in about one month. We are quite confident that the injunction will not be granted, as it is a notorious fact that the Rio Grande is not and never has been a navigable stream in fact.

Our company is operating under dam and reservoir rights granted by the Interior Department, under act of Congress approved March 3, 1891.

CONCRETE DIVERTING DAM FOR THE RIO GRANDE DAM & IRRIGATION CO.

In connection with the article immediately preceding this we present below some information regarding the other work of the Rio Grande Dam & Irrigation Co. This information was sent to us by W. C. Bradbury & Co., contractors for the dams. Since the preceding article was written a temporary injunction against the construction of the dams has been granted.* The matter sent by W. C. Bradbury & Co., with some abbreviation to avoid a repetition of the facts given in the article above by Mr. Campbell, is as follows:

The project of this company contemplated the construction across the Rio Grande River at Elephant Butte, about 100 miles above El Paso, of a solid masonry dam, 96 ft. high, 300 ft. long on the bottom, and about 550 ft. long on top, with ample spillways 500 ft. long and 10 ft. below the crest of the dam, through solid rock on the east side.

The plans for this dam provided for a battery of eight 48-in. steel pipes, provided with steel gates on the up-stream side, and geared valves on the down-stream side of the dam, to control and regulate the flow of water from the reservoir above to the natural channel of the river below, from which it could be again taken up by a series of weirs (or dams) to be located at different points further down stream, and by them diverted into the irrigating canals existing and to be hereafter constructed. The site of this proposed dam is in a natural box canyon with walls on either side, and the foundation is of solid sandstone.

The construction of this dam, however, has not yet been commenced, and work so far done by this company consists of the construction of the first of a series of diversion weirs (or dams) referred to, the construction of seven miles of canal from the same, and the construction of a series of pipe lines or inverted siphons for conducting the water of the canal from the west side of the Rio Grande River to the east side, 11 ft. under and beneath its bed, to be then, by a continuation of the surface canals, conveyed to the points of distribution. (This submerged crossing is described in the previous article.—Ed.)

This weir across the river is located at Old Fort Seden, about 60 miles north of El Paso. It is about 400 ft. long, and the foundation of the weir proper is five parallel rows of 2 ft. round piling, driven 5 ft. c. to c. each way, to about 6 ft. below the average bed of the river. The details of the weir are shown by the accompanying illustrations.

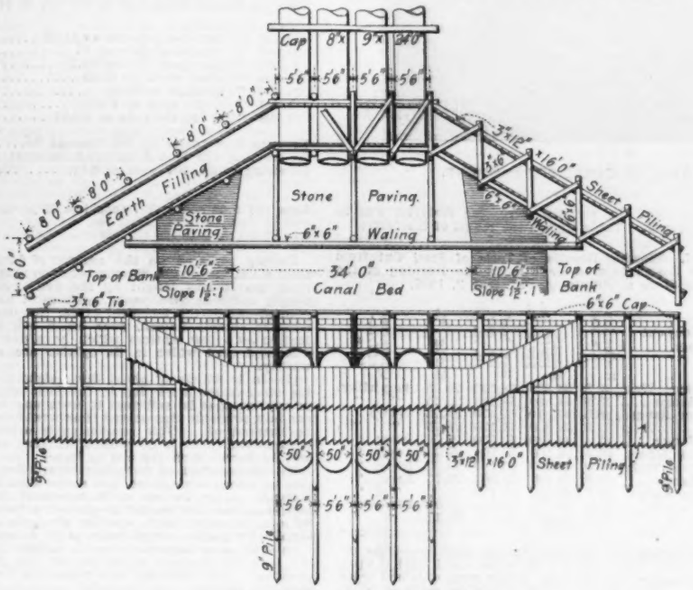
The cofferdam is composed of 6 × 12-in. tongued and grooved sheet-piling, 22 ft. long, made of three pieces of 2 × 12-in. × 22 ft. stuff, bolted together. This sheet-piling is left in the completed work to protect the round piling from possible under-cutting, and also in a measure bring to the surface the underflow when the river is very low or entirely dry.

The tops of round piling are tied together with heavy timbers, which also act as the floor of the concrete weir, which is 20 ft. wide and 10 ft. high. At the west end of the weir is located a battery of three gates and steel pipes 4 ft. inside diameter, for the purpose of scouring or diverting the crawling sand from entering the canal through the headgates proper. Beyond these gates are the headgates proper, six in number, which admit the water to the canal through six 48-in. steel pipes.

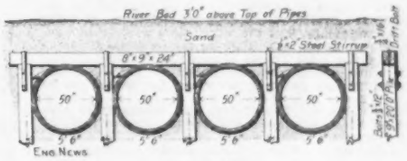
The foundation for these gates, pipes and waterways, as well as the walls for same, and the abutments and wing walls to the weir,are round piling the same as in the weir, and the floors, walls and wing walls are of concrete, composed of crushed rock and English Portland cement, the walls being 18 ft. high.

After driving a few of these pilings, the quicksand became so compact from the constant jar, that, notwithstanding we were using the latest pattern of railroad steam pile driver, made by the Vulcan Iron Works, with a weight of over 6,000 lbs. resting on the pile, and an 1,800-lb. hammer, striking 60 to 70 blows a minute, it was impossible to get the piling down, and we overcame this difficulty only by the introduction of a powerful water jet, propelled by an 18-HP. boiler, the jet being attached to the piling, and preceding it down. The water was kept from the cofferdam with 8-in. centrifugal pumps.

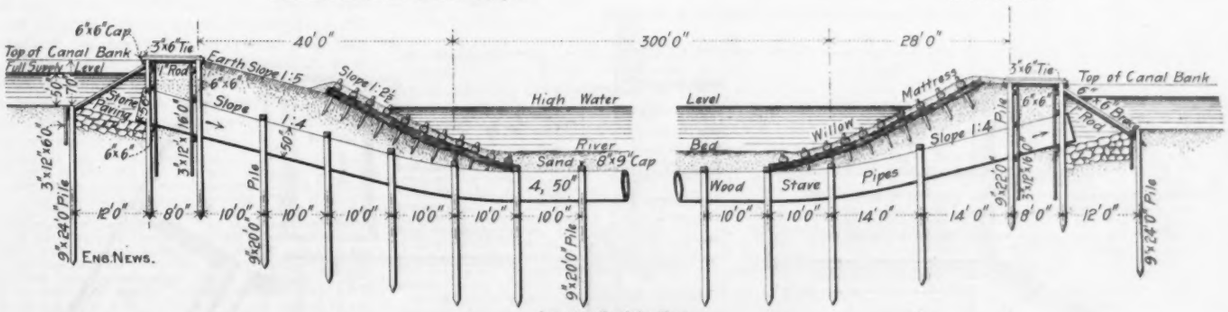
*As will be seen from the news note published in another column of this issue, the injunction has just been dissolved.



Plan and Elevation of End of Pipes.



Cross Section.



Longitudinal Section.

FIG. 2.—DETAILS OF SUBMERGED WOODEN PIPES ACROSS THE RIO GRANDE RIVER.
J. L. Campbell, Chief Engineer.

REPORTS OF INSURANCE COMPANIES' EXPERTS ON THE PITTSBURG, PA., FIRE.

Reports of three different investigations to determine the causes and extent of the damage sustained by fireproof buildings in the Pittsburg, Pa., conflagration of May 3, 1897, have recently been published by experts who examined these structures on behalf of the insurance interests concerned. All of these reports deal more particularly with the Horne store building, which suffered the most severe insurance loss, and say but little regarding the Horne office building or the far-less damaged Methodist Book Building. As indicating the manner in which this fire and its action upon fireproof buildings impressed the insurance experts, and, as giving the ideas of these interests in some degree as to the defects which this conflagration has shown to exist in fireproof construction, parts of these reports are of considerable interest to engineers. In our issue of May 20, we described at much length the progress of the Pittsburg fire and the damage done by it, reporting information gathered by a personal investigation of the ruins and a careful study of all the available evidence, and this description can be reviewed with advantage in connection with the insurance experts' reports which are abstracted herewith.

Report of Official Appraisers' Engineering Committee.

From an engineering standpoint the most valuable of the reports mentioned is the one made by a committee appointed to aid the official appraisers and composed of Mr. Gustave Kaufman, M. Am. Soc. C. E., Consulting Engineer; Mr. Emile Swensson, M. Am. Soc. C. E., Superintendent Keystone Bridge Works, and Mr. F. L. Garlinghouse, Chief Structural Engineer, Jones & Laughlins, Limited, all of Pittsburg, Pa. The duty of this committee was to report upon the condition of the steel framework of the Horne store building alone, and the following is an abstract of this report, except those parts describing the progress of the fire and the various structural features already described in Engineering News of May 20:

General Effects of the Fire.—The wreck of the eastern side of the building was caused by the falling of the water tank, weighing when filled 26 tons. This was supported by I-beams, the dimensions of which could not be ascertained. The widely published statement that the tank was supported by wooden beams was erroneous. Judging from the warped and weakened condition of the remaining ceiling tees in the western part of the building, a fair surmise would be that the ceiling underneath the tank, which was located right beside the elevator shaft, gave way under the heat, which was no doubt fiercer there than in any other place in the building. The fall of the ceiling exposed to the action of the heat the unprotected columns

of the sixth story between the ceiling and the roof, and also the roof beams and those supporting the tank. These no doubt yielded on account of their loads and the action of the heat, and thus permitted the heavy tank to fall. The tank in falling carried with it to the first floor such columns and beams as it came in contact with, and these in turn dismantled a large number of beams and girders to which they were connected. The board did not make a critical examination of the fireproofing, because the determination of the amount of damage done to fireproofing was not one of its duties. It is pertinent, however, to say that many of the lower webs of the floor arches dropped out, and that a great deal of the fireproofing on the underside of the beams and girders also fell off. The former, your board believes, was due to the lateral movement to which the building was subjected by expansion and contraction, and the other to the doubtful method of attachment. The ceilings of the upper floor were not subjected to any force of water.

FIG. 5.—WILLOW MATTRESS FOR PROTECTION OF PART OF CANAL EMBANKMENT.

Columns.—Each column in the building was first examined with the transit instrument, and then the results of this examination were verified by plummet observations, together with a close visual scrutiny. It was impossible to make plummet observations of the whole tiers of columns from the roof to the first floor, except those around the light well. These were, as is usual with all plummet observations, rather unsatisfactory on account of the oscillations of the plummet. A general statement of these observations would be that the whole tiers were from 1 in. to 2 ins. out of plumb, and that the intermediate columns were on different sides of the plumb line. Tiers of columns, therefore, are in a sinuous condition, but the greatest deflection at any point in the whole tier would not be more than 2 ins.

Girders and Beams.—The girders and beams were also subjected to close scrutiny and a careful record made of each and every one. This record is shown on Tables No. 2 to No. 6 inclusive. (These tables are not reprinted, but a very good general idea of the damage done to beams and girders may be had from the statement further on which gives the weight of steel required to be removed.—Ed.) Every rivet on the building that was exposed was tapped and not one loose rivet was found. All connections were also examined, and were all found to be in good condition as far as could be determined, except those that are especially noted in the accompanying tables. (In all, some half a dozen of the shelf angles on the girders are shown by the tables to have been bent.—Ed.)

Tests of Material.—To determine to what extent the steel had been injured by the fire and what beams could be safely straightened, three very badly twisted beams were selected and test pieces were cut out as close to the bend as could be gotten. It was surmised by your board that the fire had not damaged the steel, that the store would act simply as an annealing furnace, and that the material would be improved rater than injured. The results of the tests justified the opinion of the board. Regardless of how badly bent the sections were, the material was in no case injured. Table I gives the result of the tests:

TABLE I.—Showing Results of Tests of Steel Cut from Floor Beams Injured by Fire in the Burning of the Horne Store at Pittsburg, Pa., May 3, 1897.

Test piece cut from.	Reduction of area, %.	Elastic limit, lbs. per sq. in.	Max. load, lbs. per sq. in.	Elong., %.	Character of fracture.
12-in. beam: Web	43.8	34,830	58,300	26.25	Ang. silky.
Top flange	53 8	41,340	58,850	25.75	" "
Bottom flange.	48.5	43,010	62,470	28.75	½ cup "
Web	52.9	34,800	58,120	26.75	" "
Top flange ...	47.4	42,060	59,350	24.5	Irreg. "
Bottom flange.	63.4	38,160	58,190	27.5	Ang. "
10-in. beam: Web.	45.0	41,750	65,140	25.0	Irreg. "
Top flange ...	49.3	39,500	59,260	23.75	Ang. "
Bottom flange.	44.7	40,230	60,100	25.0	" "
4x4x5-16 angle ..	19.5	39,650	52,600	15.0	Fibrous.
4x4x5-16 " ..	21.1	34,850	51,780	21.25	"

After obtaining the data showing the condition of the individual pieces in the frame work, your board marked upon the floor plans of the building, which were obtained from the builders, those pieces which should be replaced with new material and those which should be taken down, straightened and replaced. Beams and columns having deflections or bends of ½ in. or under were not disturbed and were permitted to remain in the building, it being the opinion of the board that the strength of this structure would not be reduced or jeopardized by so doing. It would not be just to ascribe the sinuosity of the various tiers of columns to the action of the fire alone, as possibly a small amount of it existed originally. The fact of the southwest corner being 2 ins. out of plumb was also a matter which presented no serious phase to the board. While it no doubt was proof of the lateral movement of the structure westward, however, because the wall is firmly held by the steel frame work, the board was unanimous that there were no reasonable grounds that it should be disturbed. Had it been a brick wall depending upon its own weight for stability, a different decision would have been arrived at. To do away with any error that may have crept in, the floor plans, as marked, were carefully examined at the building and checked.

With these drawings on hand it was but a simple matter to calculate the weight of the different classes of material to be furnished and work to be done. These being found, it was only necessary to apply the different values of the work to be done in order to arrive at a close determination of the damage done to the steel framework. From this the following statement was deduced:

Dismantling:—		
Scrap	50 tons	
Material to be straightened	236 "	
Material necessary to be dismantled on account removal of supports	124 "	
Total	410 "	
410 tons at $12.00		$4,920
236 tons straightening and re-erecting at $18.00.....		4,248
New Material:—		
274,936 lbs. punched I beams at $1.40	$3,849	
21,684 " riveted girders at $2	434	
73,900 " punctured T's at $1.70	1,256	
9,160 " truss work at $3.50	321	
24,392 " columns at $2.60	634	
5,570 " ⅝ in. rods at $2.60	139	
4,286 " ¾ in. tie rods at $2.50	107	
		6,740
Erecting new material, 207 tons at $9.....		1,863
Re-erecting 124 tons dismantled material at $9 ..		1,116
Handling scrap, 107 tons at $4		428
		$19,315
Less 157 tons scrap (207 tons less 25%) at $5		785
		$18,530

Having reported on the amount of damage done the steel work, it remains for the board to make its comments upon the lessons taught by the fire. Much pertinent matter could be dwelt upon, and much has already been pointed out by the technical press. Not desiring to repeat what is already known, your board will merely call attention to a few matters which have not been generally discussed, and which in its opinion are especially noteworthy.

(1)—In buildings of about this height the distortion of the steel frame work due to the heat of the fire cannot in any instance be sufficient to work any serious damage; nor is it probable that at any time would connection rivets be sheared off. This conclusion is arrived at for the reason that there is no probability that any future fire will be fiercer than the one at issue.

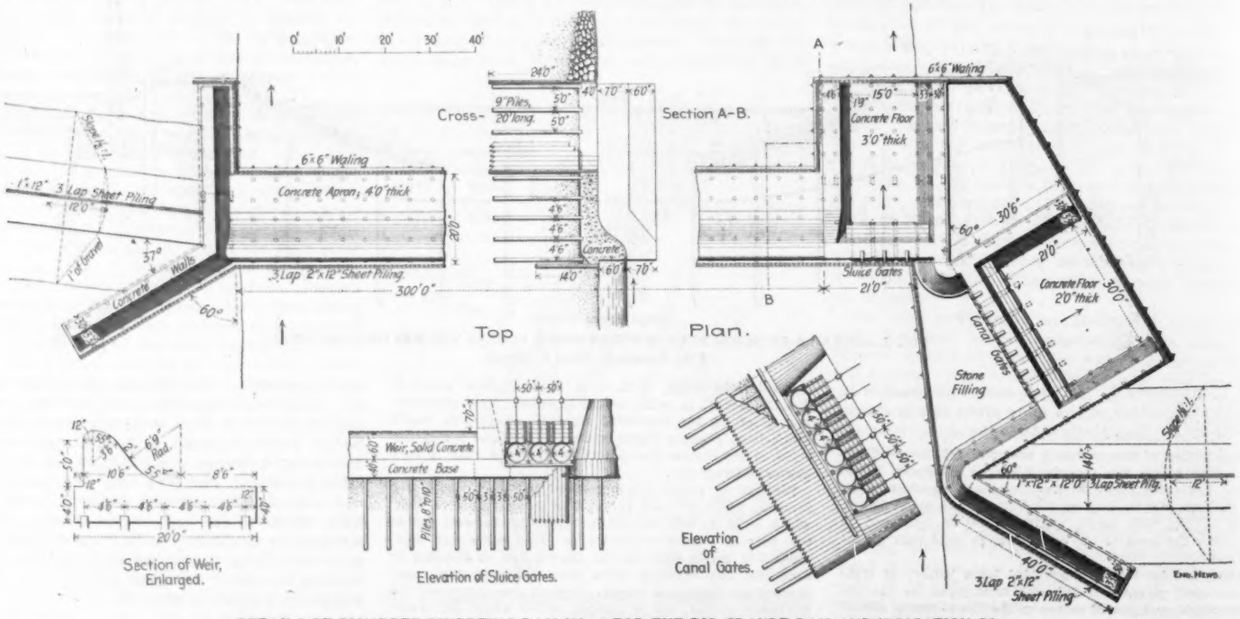
(2)—The method of fastening fireproofing to the underside of beams with sheet iron strips should be discarded.

(3)—It can not be too often reiterated that open front buildings like this should be protected from external fires by metal shutters, and also that all shafts should be provided with readily-closed doors at all floors.

(4)—The most important lesson taught by this fire was the lack of strength developed by the fire clay fireproofing. The building was permitted to move in any direction without any material restriction by the fireproofing. The floor arches showed by the scaling off of the lower webs that they were unable to offer any sufficient force to counteract the tendency to lateral motion.

(5)—The column protection, although composed of the very best obtainable kind of fire clay tile, was also not of sufficient strength.

In our opinion it would have been necessary to dismantle the whole steel frame work had this structure been 14 or 15 stories high. The leaning at that height, at the same



DETAILS OF CONCRETE DIVERTING DAM NO. 4 FOR THE RIO GRANDE DAM AND IRRIGATION CO.

protection as developed, would have entailed the necessity of taking the whole structure down.

Owing to the fact that steel columns or girders or beams after being subjected to a long continued fire will assume the same temperature as fire-proofing, and owing to the fact furthermore that the rate of expansion of the steel is much greater than that of the fire clay tile, destructive movements are permitted which, as shown in this experience, will result in considerable damage, and which damage will increase in direct proportion to the height of the building.

In view of these important developments, it is our opinion that important structures of this class should have a radically different method of fire-proofing. The fire-proofing should be in itself strong and able to resist severe shocks, and should if possible be able to prevent the expansion of the steel work.

There seems to be but one material that is now known that could be utilized to accomplish these results, and that is first-class concrete. The fire-resisting qualities of properly made concrete have been amply proven to be equal, if not better, than fire clay tile, as shown by the series of tests carried on by the Building Department of the city of New York.

From experience gained in street railway construction in laying continuous rails, it is to a large degree possible to prevent the metal from expanding. In street railway work this has been accomplished merely by the adhesion of the pavement to the side of the rails. In building construction the same results could be obtained by encasing the columns and girders with concrete placed directly against the steel work. The adhesion of the concrete would to a large degree prevent unequal expansion of the concrete and steel. The floor arches should also be constructed of concrete, but of sufficient depth to be able to resist lateral forces. With the prevention of injurious expansion and the protection of columns with materials that can stand severe shocks of any nature whatever, the modern steel frame constructed building would be more thoroughly protected against any fire.

The construction herein suggested should not materially increase the cost of construction. The solid concrete about the columns would be added strength to the same, and could no doubt be made self-supporting. The same could be said of concrete surrounding beams and girders, as has been amply demonstrated by the strength developed by concrete iron construction, such as the Monier and Melan arches.

One of the objections that would be raised against this construction would be that it could not be carried on in freezing weather. This is a proper objection, but there is no valid reason, in our opinion, why these structures should be built in winter any more than were the old-time brick structures.

As so-called fire-proof buildings are not equally and to the same degree protected against fire, we would recommend to the insurance companies that they should vary the rate of insurance for this class of buildings, depending upon the character of the fire-proofing used. The competition between the fire-proofing companies has been so severe as to reduce the price of their output, in very many instances at the expense of quality. The large fire loss in the Horne building would still have been larger had the fire-proofing been of poor quality; and we would further recommend that the insurance companies have prepared standard specifications governing the character of the fire-proofing and the construction and putting up of same, and requiring owners of buildings to use fire-proofing subject to these specifications, under careful inspection, or be subjected to higher insurance rates.

Official Appraisers' Report.

The official appraisers appointed to adjust the damage done to the Horne store were Mr. Samuel R. White, General Contractor, of Bloomington, Ill., appointed by the insurance interests, and Mr. Adam Wilson, of the contracting firm of A. & S. Wilson, of Pittsburg, Pa., appointed by the owners of the building. Only a small part of the appraisers' report is of especial interest to engineers, and this we abstract as follows:

In putting on fire-proofing we think it should be done with fire clay or cement, and not with lime mortar, and that all space between the tile and the iron should be filled in solid. We also think that all portions of the structure between the ceiling and the roof should be well covered, as the heat always goes upward. In this fire the intense heat of all the floors in the store building rushed up the light shaft, elevator and staircase openings, and the top portion, having no fire-proofing, simply melted and let the tank that was placed on the top of the building plow its way through the several stories, each adding as it went its own weight and contents, until all landed in the basement. We do not think it necessary to put these tanks on the roof, as they can be placed in the basement and give the same results; but if they must go there, then place them over some alley or on a fire-proof base, so they will not endanger the entire structure.

In regard to protections on the outside openings, there is nothing better than the standard wood shutters covered with tin, which were used on the rear of the store building. These remain to speak for themselves, and show that they confined the flames and heat to the inside of the walls. If they had given way they would have communicated the fire to the wood structure in the rear. As these shutters are unsightly on the front of buildings rolling steel or asbestos shutters could be used, a number of kinds of which are on the market. We would also advise that all stairs and elevator openings be enclosed on all sides (excepting doors) with tile protection, with an extra rolling shutter for the doors which can be closed when not in use and at time of fire. In regard to light shafts, where it is necessary to have them open with only a balustrade, as in stores, they can be protected by an asbestos covering made to roll up and come together in the center. In office buildings and flats they can be provided with the regular standard wood shutter, or the rolling steel or the asbestos shutter.

The stone basement, walls, footings, etc., were practically uninjured. The stone sidewalk on the two sides was a total loss. The ashlar and cut stone on the front and side, where subjected to heat, were a total loss, and in addition to replacing them with new ones, it costs considerable to remove them and cart them to the dump. The terra cotta work, where it was subjected to great heat, proved a failure from a builder's standpoint, as lots of uninjured brickwork had to be taken down to replace the terra cotta. The brick stood the great strain remarkably well, and there would not have been 15% loss on it if the other members of the structure had stood the strain as well, the greatest part of the damage being caused by the falling of the tank, which, with what had to be taken down, would make the loss at least 40%. The copper cornice was a total loss, except as scrap. This was on account of being constructed on wood lookouts; had it been on steel lookouts and fire-proof, there would have been little or no loss.

The fire-proofing in this building was of hard tile side construction, and we must admit that it stood well when we take into consideration the intense heat and the jar it was subjected to when the tank fell, carrying away over one-third of the building. As it is, there was a salvage of 16⅔%, and we believe if the tank had not fallen the salvage would have been at least 50%. We believe that this same class of material of the end construction made heavier throughout, with an extra web to strengthen it and properly put up, would stand any kind of ordinary fire. The absence of panels in ceiling, we think, would also be an advantage, as the plain ceiling stood all right; the light iron frame giving way caused the damage. The elevators, staircases, plumbing, electric wiring, etc., were all practically destroyed, and the only way in which they can be protected is to enclose them in fire-proof rooms. The concrete used for floors is often defective, as much depends on this to protect the fire-proofing from heavy weights and sudden blows. The woodwork on the entire two buildings was practically a total loss. The only remedy for this is to place as little woodwork in a structure as possible, and where wood partitions are used put on asphalt or fire-proof paint, which will prevent the spread of the fire. The damage to the steel in the store building, outside of damage by the falling of the tank, which tore away the fire-proofing, would not have exceeded 5% of the entire cost of the same. As it was, when taken into consideration the taking down of much material uninjured in order to get at the balance, the loss will not exceed 16⅔%. The fire-proofing in the Horne Office Building was, of course, hollow tile, and the entire loss to fire-proofing, except partitions, was 33⅓% of the entire cost. The loss on partitions partly caused by a wood strip being put in to form a ground for the base, was 43% of the entire cost. This building was subject to as much or more heat from the outside, but did not have as much inflammable material on the inside.

Report to the Tariff Association of New York.

After the report of the engineering committee of the official appraisers one of the most valuable

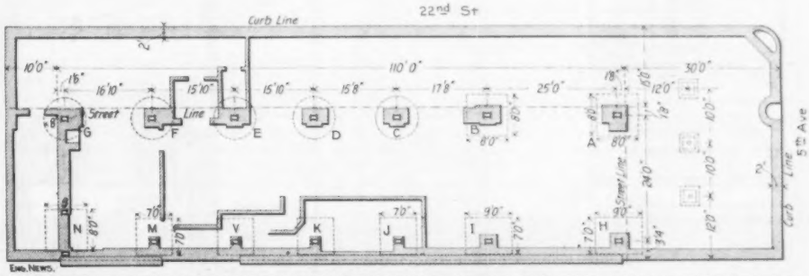


FIG. 1.—FOUNDATION PLAN OF THE MERCANTILE BUILDING, NEW YORK CITY, SHOWING ARRANGEMENT OF THE 14 PNEUMATIC CAISSONS.

Stephens & O'Rourke, New York, Contractors and Engineers.

investigations was conducted by Mr. S. Albert Reed, manager of the Tariff Association of New York. After outlining the progress of the fire in the Horne store about as was done in our issue of May 20, Mr. Reed says:

Any unprotected iron or steel speedily became red hot and in such condition was ready to bend like putty. But none of the skeleton lacked protection except at one place, viz.: the cock loft under the roof. The steel girders and beams supporting the tile roof were entirely bare and had no protective covering at all. The designers of the building evidently relied for protection upon the suspended ceiling of flat tiles carried by light angle or T-bars. In this they made their error, and this error is responsible for nearly all the structural damage to the skeleton and walls.

At the place where the well and elevator section passed through this cock loft there were bulkheads of ordinary partition blocks carried by light angle or T-bars, these bulkheads shutting off the cock lofts from the wells. These light bars, with poor protection, if any, got red hot and yielded, dropping out the partition blocks and opening up the cock loft to the passage of flames. The bulk of the up-draft of flame being on the east side where the big shafts were, as soon as the flame began to pour through the opened-up cock loft, the light, unprotected beams and girders there quickly became red hot and collapsed. Furthermore, the columns of the sixth story which carried the roof were protected by tiling only up to the ceiling. In the space between ceiling and roof they were entirely bare. This can be seen to-day in the still standing portion of the cock loft to the west of the large well. These columns also got red hot between ceiling and roof and bent readily. Aiding the collapse was the great weight of the water tank. But I consider it erroneous to ascribe the collapse primarily to the water tank, or to ascribe the fall of this tank to imperfection in its own supports. If the roof skeleton and the columns above the cock loft had been properly protected, the tank would have remained in place.

The collapse of the roof and the fall of the water tank and roof members, Mr. Reed thinks, were largely responsible for the wreck of the tile arches and such injury to the steel frame as was found. The damage to the steel-work is given as follows: Roof with supporting columns on the sixth floor about two-fifths gone, the remainder not injured structurally; of 120 columns five are damaged or gone, as are four out of 168 girders, and 40 out of 960 beams. The value of the skeleton injured to the total skeleton value is given as probably about 5%. Mr. Reed thinks that the supposed hazard of expansion, warping and twisting of the metal framework is disproved by this fire, and believes that the standing part of the steel-work is practically as good as when put up. He thinks also that the injured columns and beams are either those which were unprotected and, getting red hot, yielded and bent from the weights they had to sustain or those which were displaced, carried down or bent by the shock of falling wreckage. Speaking further of the floor arch damages, he says:

It has been said above that practically no floor arches were lost or broken through by the action of fire and water or expansion, but that the falling wreckage is responsible for all the broken floor arches. Now, although four-fifths of the arches were standing after the fire and one could walk safely over them, there is, nevertheless, a damage throughout the building to the upper side of these arches by the breaking and dropping out of the webs. Few arches escaped this damage. Also, there is a very extensive stripping of the structure of the underside of the beams (not girders) by the breaking of the side webs and beam flanges of the skewbacks. The girder and column protection is very little injured throughout the building, except where it is torn off by the falling wreckage.

Mr. Reed considers that the best way to utilize the information furnished by this fire is to see whether it corresponds to the anticipations of insurance men as to what would happen under the circumstances. Considering that the lack of protection to the ironwork in the cock loft is a recognized defect to be covered by a charge in the insurance rate, he believes the results to have been what might have been anticipated except for the action of the floor arches, to which he refers as follows:

There is one matter, however, upon which this fire teaches us that we must revise our theories and practice, and that is the matter of the floor arches. It is, perhaps, not right to say a revision, because hitherto we have had no positive views to revise. We have all along said we don't know how serious the damage is likely to be to these hollow tile floors, and we don't know which style or make is the best, and we cannot tell until we get some big fires to teach us. Well, we know now that, in a building with hard tile arches of what is known as side construction, you may find after the fire all the arches in place and be able to walk fearlessly all through the building, and yet you may have to take all these arches out and figure them as a total loss. A tile arch of this character may lose enough of its lower webs under the action of heat, expansion and strain, and perhaps water, to make it quite probable that no patching up will be accepted in an adjustment.

The question of skeleton protection I consider as settled by this fire. With good protection the skeleton may absolutely be relied upon to stand even a conflagration. We must now proceed also to discriminate among risks according to the floor arches that are used. We have seen, as above stated, that even a pretty poor floor arch will stand through a big fire and be in shape to walk over and to stand weight tests, and to be a perfectly good fire stop and apparently strong enough to leave standing with merely a renewal of the ceiling surface; and yet it may all have to be knocked out and replaced by a new arch, involving a total loss to the entire floor cost of the building, a very considerable item. We have always felt and said that this was a possible contingency. Now we know that it is an actual reality.

As to the problem of protecting large windows opening on a street against exposure, that is a question I will not go into. It has nothing to do with fireproof buildings more than with buildings of other types of construction. Underwriters have always known that fire will get in pretty easily through a front of which three-quarters is glass, and such exposures are, or should be, met by proper charges, unless ingenuity will furnish us with some practicable scheme for protecting these large front openings, and owners are brought to find that it pays to adopt the protection recommended—if in turn we have it to recommend!

Report to the Individual Underwriters' Association.

The last of the reports mentioned was made to the Individual Underwriters' Association by Mr. John R. Walters, Attorney and Manager, and the gist of it is contained in the brief remarks concerning the use of sprinklers and the general

conclusions which the author thinks are to be drawn from the fire. Regarding the use of sprinklers, the report says:

It is the concensus of opinion of the several experts who have reviewed the circumstances of this conflagration, and this office is convinced, that an equipment of automatic sprinklers in the risk of Joseph Horne & Co. would not have saved its contents from destruction. The presence of standard tin-clad fire-doors and shutters on Penn Ave. might have kept out the fire, but the design of the building, as well as the character and needs of the business, precluded the adoption of this protection, except on walls not fronting on streets. On the other hand, it is certain that the chances of loss would have been very greatly reduced had Joseph Horne & Co.'s premises been equipped with outside sprinklers, which, where the openings are numerous, are less expensive than fire shutters, and have the additional advantage that they may be placed upon the front of a building without disfiguring it. When the water supply and pressure are adequate, outside sprinklers will maintain a curtain of water on the outside

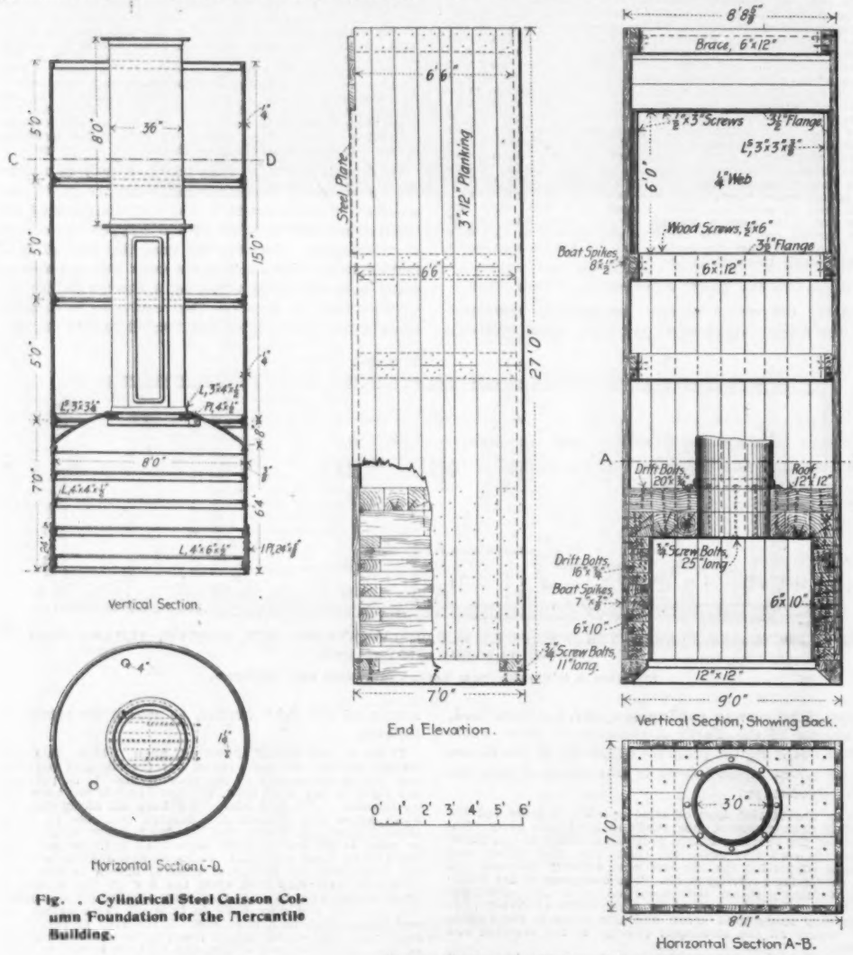


Fig. . Cylindrical Steel Caisson Column Foundation for the Mercantile Building.

Fig. 4.—Rectangular Timber Caisson Column Foundation for the Mercantile Building.

of a risk sufficient in volume to prevent the ignition of the building or its contents.

The conclusions deducible from the fire are given by Mr. Walters as follows:

(1.) That a fire-proof building lends no such quality to its contents, but, on the contrary, is apt to accelerate their destruction, while an old-style brick and stone building may fall and smother the fire, thereby making probable a large salvage on stock.

(2.) For this reason stocks in fire-proof buildings should pay higher rates of premium.

(3.) For the same reason stocks in fire-proof buildings need automatic sprinkler protection as much as, if not more than, stocks in ordinary buildings.

(4.) That owners of stocks in fire-proof buildings do well to keep them fully insured, especially if exposed to neighboring risks.

(5.) That an outside sprinkler equipment, in the judgment of this office, affords better protection against the neighbor, and is usually cheaper than any kind of shutter or door, and that subscribers should therefore give that device their earnest consideration.

The final adjustment of values, losses and insurance for the Horne store and office building, as published by the official appraisers, is as follows:

Horne Store Building.

	Sound value.	Loss.	Insurance.
Building	$367,980	$206,747	$278,000
Boilers	9,000	4,440	20,000
Dynamos, etc.	10,000	9,500	2,000
Total	$386,980	$220,694	$300,000

Horne Office Building.

Building	$114,322	$58,885	$60,000
Boilers	6,000	207	4,000
Total	$120,322	$59,092	$64,000

For the store building alone it will be seen that ratio of loss to value was 56.18%, and the ratio of insurance to value was 75.5%. We comment editorially on another page of this issue on some features of these several reports.

PNEUMATIC CAISSON FOUNDATIONS FOR THE MERCANTILE BUILDING, NEW YORK CITY.

In Engineering News of Jan. 7, 1897, a foundation consisting of two timber caissons 12 × 24 ft., and one 15 × 24 ft., designed by Stephens & O'Rourke, of New York, N. Y., for the 19-story Gillender Building, erected at the corner of Nassau and Wall Sts., in that city, was described in detail. This same firm of engineers has recently completed a foundation consisting of nine timber and five steel caissons for the Mercantile Building, now being erected by Mr. Henry Corn, at the corner of 22d St. and Fifth Ave., which is somewhat notable for the number of small caissons used and the rapidity and success with which they were sunk without disturbing the neighboring structure. The accompanying cuts illustrate the construction of these caissons and such other features of the foundation work as are of particular interest.

The new Mercantile Building is a 12-story steel skeleton structure, having the basement dimensions shown by Fig. 1. It will be seen that two rows of seven columns each are erected in the lines of the longitudinal side walls of the building, and that each column is supported by a separate caisson. The principal trouble feared, and which, it may be stated here, did not manifest itself, was the possible settlement of the wall of the adjacent building, close against which seven of the caissons were sunk. During the sinking of the caissons it was necessary to shore up this wall and then to underpin it with new masonry when the sinking was completed. The system of shoring was rather interesting and is explained by the sketches shown in Fig. 2. Sketch A shows the manner in which the wall next to caisson H was supported, and sketch B shows the supports at caisson M. It will be noted that the system left the minimum amount of timbering in the working space, and at the same time all adjustments, that is, raising and lowering of the shoring, were accomplished at two points, namely the screw jacks, handy to the workmen about the caissons.

As already stated, two kinds of caissons were used, viz., rectangular timber caissons and cylindrical steel caissons. The steel caissons were all of the same size, and a description of one will do for all. The timber caissons varied in their dimensions, but the general construction of all was the same and, therefore, only the largest, 7 × 9 × 27 ft., will be described. Fig. 3 shows the main dimensions and general construction of the steel caissons, five of which were used. The bottom 7 ft. of the cylinder formed the working chamber, which was roofed over and provided with a 3-ft. diameter manhole cylinder in which was placed the air lock. Details of this air lock, which was of special design, are not available, but it may be stated that the peculiar features of its design were intended to facilitate its operation to provide for the frequent passage of the spoil bucket up and down through it. All material, as will be inferred from the preceding statement, was removed by cylindrical buckets hoisted up and down through the single manhole by a suitably arranged derrick.

The general details of the 7×9-ft. caissons shown by Fig. 4 shows the construction of all the timber caissons used except for a few minor details. It will be noticed that the manhole of the caisson illustrated is located considerably to one side of the center. This construction was adopted for all of the caissons of the inside row except caisson J, and its purpose was to provide more room for the hoisting bucket in working those caissons close to the adjacent building wall. Caissons A, B and J had the manhole in the center. As will be seen drift bolts and boat spikes were used entirely for fastening the timbers, except in a few places, at which especial rigidity was necessary, where wood screws and screw bolts were substituted. For the 7 × 9-ft. caissons about 5,970 ft. B. M. of timber was used, and for the 8 × 8-ft. and 7 × 7-ft. caissons 6,121 ft. B. M. and 5,050 ft. B. M., respectively. The material for each caisson cut and dressed exactly to dimensions was brought to the ground and the caissons erected on their sites by the contractor's forces.

Besides the rapidity with which the work was done and its entire lack of disturbance of the neighboring building wall, the sinking of the caissons possessed few features out of the ordinary. Solid rock underlay the entire foundation area at a depth of from 20 to 25 ft. below the cellar bottom, and each caisson was sunk to this firm material. The material which they penetrated was somewhat irregular, but was generally a mixture of clayey loam and sand, often quite unstable. The water line was about 2 ft. below the cellar bottom, and from 3 lbs. to 11 lbs. of air pressure were required to hold it. Three men were worked in the timber caissons and four in the steel caissons, who loaded into cylindrical steel buckets passed up and down through the manhole. To handle the buckets two derricks were used, one placed at each end of the foundation area, and to supply the air a compressor was located under the sidewalk on the 22d St. side of the cellar. Fig. 5 is a view showing the work in progress from which a fair idea of the constructions and operations described above may be had.

Altogether 14 caissons were sunk between May 22 and June 18, or in 27 days. In the accompanying table is given the size and character of each caisson, the depth to which it was sunk and the time taken to do the work. As each caisson reached the bottom the rock was leveled off and a foundation bed of concrete 2 ft. thick placed to support the timber or steel structure. The shell of the caisson was then filled with concrete and

capped with a steel I-beam and concrete grillage to carry the base of the building column.

The contractors for the foundation were Stephens & O'Rourke, of 44 Broadway, New York city, and the work was in direct charge of Mr. John F. O'Rourke, M. Am. Soc. C. E., of that firm. The contract included the designing and construction of the caissons, as well as sinking them to place and doing the necessary shoring and filling to fit the foundation ready for the steel contractor. We are indebted to the contractors for the information from which our description and illustrations have been prepared.

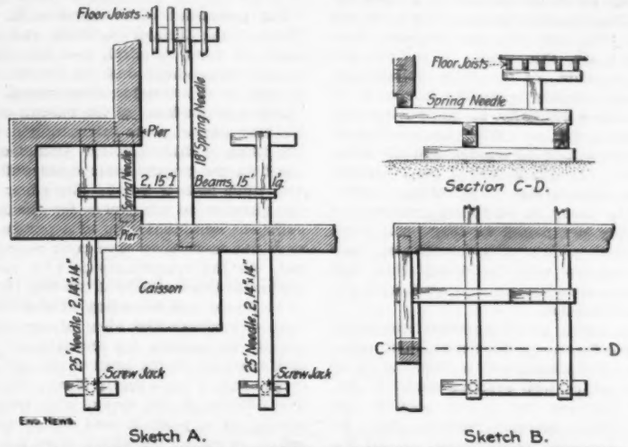


FIG. 2.—DIAGRAM SHOWING MANNER OF SHORING UP ADJACENT BUILDING WALLS WHILE SINKING THE CAISSONS FOR THE MERCANTILE BUILDING.

Table Showing Size, Depth Sunk and Time Required to Sink 14 Caissons for the Mercantile Building Foundations, New York City.

Caisson.	Material.	Dimensions.	Sinking—Began.	Sinking—Finshd.	Actual wrkg time, hrs.	Dpth sunk, ft.
A	Timber	8 x 8 x 27 ft.	May 22	May 29	104	21.07
B	"	8 x 8 x 27 "	May 29	June 1	64	24.37
C	Steel	8 ft.* x 22 ft. long.	June 8	June 10	41½	22.14
D	"	8 " x 22 " "	June 13	June 16	78	23.78
E	"	8 " x 21 " "	.....	.....	..	25.37
F	"	8 " x 22 " "	June 3	June 5	54	19.53
G	"	8 " x 22 " "	June 6	June 7	35	17.38
H	Timber	9 x 7 x 27 ft.	June 4	June 7	67	21.57
I	"	9 x 7 x 27 "	June 1	June 4	72	21.21
J	"	7 x 7 x 27 "	June 11	June 14	76½	22.97
K	"	7 x 7 x 27 "	June 11	June 13	47½	20.67
L	"	7 x 7 x 27 "	June 17	June 18	39	22.62
M	"	7 x 7 x 27 "	June 8	June 10	50	18.07
N	"	8 x 8 x 27 "	June 14	June 16	47½	19.67

* Diameter.

RULES FOR CONDUCTING ARCHITECTURAL COMPETITIONS.

The Society of Beaux Arts, of New York City, at a late meeting, very clearly set forth the views of its members upon the subject of competition. These views were expressed in the form of a series of recommendations, intended for the guidance of members in practice, as follows:

1. Members of this society should do all in their power to discourage competition for all but public or semi-public buildings, as defined below.

2. It is the sense of the society that all public buildings should be the subject of competition.

3. Competition for public buildings or for semi-public buildings erected by private means for the use and benefit of the public, such as important churches, hospitals, libraries or colleges, etc., can only be entered with the approval of this society, if safeguarded by conditions which the society deems essential to their fairness and success, and to the self-respect of the participants.

4. The following are the conditions deemed essential to the fair and orderly conduct of a competition.

A. That a professional adviser shall be appointed by the party instituting the competition, whose duty it shall be to assist in the preparation of the programme, to assume all and direct relations with intending competitors, receiving and answering all communications and giving all information in writing to all intending competitors alike; to examine all drawings or other matter called for by the programme, and place out of competition and return any that do not conform to the terms of the programme; to make a selection of one design as the best and to submit his selection, together with his reason therefor, to the parties instituting the competition.

B. That if the proposed work be of sufficient magnitude, a jury of award of at least three shall be put in charge, to include the professional adviser of the party instituting the competition and one or more architects named by a vote of the competitors. This jury to have the same duties and powers as above given to the expert adviser.

C. That the author of the design selected by the expert adviser or jury shall be appointed the architect of the work.

D. That the architect of the building shall receive at least the rates of compensation established by the schedule of the American Institute of Architects.

E. That the programme shall be full and explicit on all the above points, and, besides, shall fix a definite time and place for the receipt of drawings, give all useful or necessary information as to lot and surroundings, and as to requirements for occupancy; fix the number, scale, and character of drawings, give essential details as to construction and materials, and prescribe definite limits regarding descriptions, etc., which shall accompany the drawings.

AN INTERESTING REVISION OF THE SPECIFICATIONS for asphalt pavements in Omaha, Neb., has been prepared by Mr. Andrew Rosewater, M. Am. Soc. C. E., City Engineer, and approved by the Board of Public Works and the City Council. These revisions are the development of considerable investigation and study. Primarily, Mr. Rosewater aimed to reduce the cracking of asphalt pavements to a minimum. From observations in a number of cities subjected to extremes of temperature, Mr. Rosewater noticed that formulas for paving mixtures for different sections of the same city developed very different results, and from this concluded that the fault heretofore sought in and attributed to the paving mixture was due to extraneous causes, notably the foundation.

Thus in Peoria, Ill., pavements laid upon the excavated streets on the hills with concrete base on clay were found very badly cracked. The asphalt pavements in the lower section of the city, with concrete upon a gravel and sand base, have practically no cracks. In Omaha, with the same extremes of temperature and similar formulas for paving mixture as at Denver, the asphalt laid on a concrete base has numerous cracks, while in Denver the pavements are comparatively free from cracks. In Omaha the base is clay; in Denver it is gravel and sand. From these and other observations Mr. Rosewater concludes that on a clay base, owing to its retentive nature, a freezing ensues and heaves up the concrete unevenly, because of the variable voids due to different-sized stone in its composition. On a gravel base the concrete, having sub-drainage, is not subjected to upward pressure incidental to freezing.

In view of this, Mr. Rosewater has provided for a subbase of broken stone under the concrete on future new pavements to be laid on clay or loam soils; also several classifications of base with broken stone and binder without any concrete whatever. He also proposes to leave a section 9 ins. wide on each side of the street, directly inside of the curbs, exclusively of broken stone to a depth of 9 ins. below the general base, to serve as a sub-drain, this to be connected at each of the sewer basins or inlets so as to provide a perpetual outlet for all moisture below the asphalt and its base.

For streets formerly paved with wooden blocks or concrete, of which there are 400,000 sq. yds. in Omaha, and to be repaved with asphalt, provisions are made for cutting open the 9-in. section at the curbs, filling with broken stone for sub-drainage, and raising the entire surface with broken stone or slag to a height so that when covered with the asphalt it will restore the paved surface to its original elevation. We are indebted to Mr. Rosewater for the above information. It is believed by him that with the proper application of these views regarding subdrainage, a harder asphalt surface mixture will be possible. He also says that it was stated before the Institution of Civil Engineers in the '80s that clay is the poorest kind of base for asphalt paving.

DAMAGES FOR DEPLETING THE FLOW of a stream through pumping water from some of the wells of the driven well system of the Brooklyn water supply have just been awarded by the appellate branch of the State Supreme Court. The lower court decided in favor of Brooklyn. It is expected that the case will be carried to the highest court of the state. The commonly accepted rule that the owner of land can develop percolating underground water to the depletion of his neighbor's supply was held as not applying here, since the city did not use the water in connection with the land owned by it. If the higher court affirms the decision, Brooklyn may be called upon to extinguish water rights affected by its driven well system, as well as rights affected by the diversion of water from surface sources.

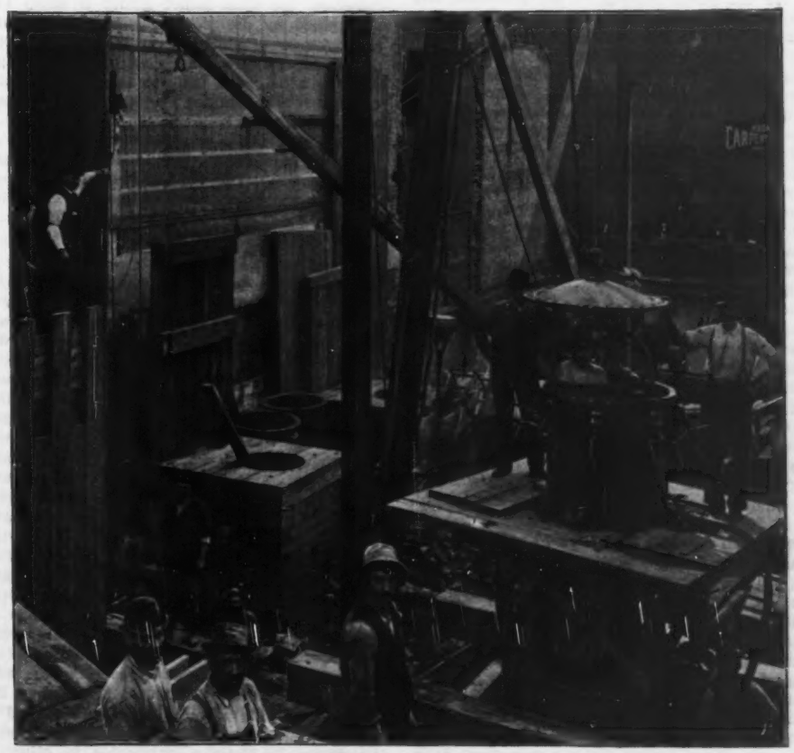


FIG. 3.—VIEW SHOWING PROCESS OF SINKING CAISSONS FOR MERCANTILE BUILDING FOUNDATIONS.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Entered at the New York Post Office as Second-Class Matter.
Published every Thursday
at St. Paul Building, 220 Broadway, New York, by
THE ENGINEERING NEWS PUBLISHING COMPANY.

D. McN. STAUFFER, Vice-President, } - - - EDITORS.
CHARLES WHITING BAKER, Secretary. }

GEO. H. FROST, President, } - - - - BUSINESS MANAGERS.
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ALFRED E. KORNFELD, New York, } - ADVERTISING
F. A. PECKHAM, Chicago, } REPRESENTATIVES.

PUBLICATION OFFICE, ST. PAUL BUILDING, NEW YORK.
WESTERN OFFICE, MONADNOCK BLOCK, CHICAGO.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00. To all other countries in the Postal Union: Regular Edition, One Year, $7.60 (31 shillings); Thin Paper Edition, One Year, $6.31 (26 shillings). SINGLE COPIES of any number in current year, 15 cents.

Mailing addresses may be changed at will by sending both old and new address. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 326 means that subscription is paid to the 32d week (that is the issue of Aug. 12) of the year 1897; the change of these figures is the only receipt sent, unless by special request.

ADVERTISING RATES: 20 cents per line. Want notices, special rates, see page 28. Rates for standing advertisements sent on request. Changes in standing advertisements must be received by Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The late Quebec convention of the American Society of Civil Engineers was especially remarkable for the subordinating of the technical and business proceedings to the more social features of such a gathering. The reading of papers and their discussion was confined to one day, and a comparatively short morning session disposed of the business on hand; the remainder of the time was devoted to excursions about Quebec and to receptions, formal and informal at the hotel. This is as it should be for the mid-summer assembly of the members of the society. As President Harrod remarked in his annual address, the good engineer is a decidedly sociable animal; and the chief profit to be derived from this particular annual gathering comes from the opportunities presented for personally knowing men of whom you have long heard but from whom you have been widely separated in the pursuit of a common calling. Engineers have enough of "shop" in the course of their regular work; and while some learned papers are, perhaps, necessary at these conventions to satisfy the local belief that engineers can only talk and think in powers of unknown quantities, the less time these papers and discussions take up, the better for the true purposes of the summer convention. A peculiarly gratifying feature of the Quebec meeting was the large number of the older members of the Society present. Some familiar faces were missed, and for others a final estimate had been handed in since the last meeting, and their earthly labors were finished, but the gathering was a representative one, and the Quebec Convention will be long remembered as one of the most enjoyable in the history of the Society. The unusually large number of ladies accompanying members, combined with the generous hospitality of the Canadian hosts of the Society, aided largely to make the event a social success without a jarring element.

The combination plate and lattice girder used in recent bridge work on the Northern Pacific Ry., as described in this and a previous issue of Engineering News, while it perhaps is not absolutely novel in design, must, we believe, be credited with being an unusually interesting departure from common practice. If, moreover, the economy of first construction is followed by structural efficiency and economy of maintenance the girder has a much broader claim on the attention of engineers than mere novelty. The idea of a combination of the plate and lattice types of web framing is of course to gain the advantages offered by a solid web in handling the heavy end shearing strains, while at the middle of the girder economy of metal and ease of shop work is secured by using a simple lattice web system. According to the experience of the Northern Pacific Ry., the saving of metal in 100-ft. girders by using the combination girder is about 1,500 lbs. per girder over the solid plate web construction. At a pound price of 3 cts., this means a saving per girder of $45, an item of no little importance where a railway company is putting in a score or more of new bridges annually, as many American railways are now doing, or will be compelled to do in years to come, as their old wooden structures become worn out. The experience of the Northern Pacific Ry. has shown also that bridge builders are perfectly ready to build the combination girder as cheaply per pound as they will build plate girders, with a fair prospect that as they become more familiar with the design they will reduce the price somewhat, as compared with the plate lattice construction.

The structural merit of the combination girder is a little more difficult to determine, but there seems to be no valid reason why a combination of solid plate and lattice web systems such as described should decrease the merits peculiar to either system, while several reasons may be thought of why a distinct improvement should result. It is not an uncommon thing, however, to find that when a way is opened to reducing metal in bridge work the advantage will often be pushed to a point in the anxiety to make as great a saving as possible, where injury results to the future durability of a structure which in America must for many years carry a constantly increasing traffic as it grows older. This species of abuse is most open to practice in designing the connections for open web systems, and in this respect, therefore, the plate-lattice girder is likely to be mishandled by designers who may look upon it too much as a money saver. It is of course hardly necessary to say that this possibility of abuse is not a valid indictment of the design itself, and it is mentioned here simply to emphasize a point likely to be forgotten by designers unfamiliar with the new construction, but yet prepossessed in favor of the advantages which it seems to offer in the way of cheapness or of suitability for peculiar conditions, such for example as the overflow of the tracks by flood waters.

Besides its development of the plate lattice girder, the recent bridge practice of the Northern Pacific Ry. is worthy of notice in one other respect. Reference is had to the use of photographs of the original drawings in soliciting bids for work and the numerous shop and office purposes where heretofore full-size blue-prints have usually been employed. Anywhere from six to a dozen sheets of drawings are required for a railway bridge of moderate dimensions, and for large structures the number is doubled. When, therefore, it comes to sending a dozen or two sets of these drawings to prospective bidders, besides making the necessary office copies, the cost of blue-printing and postage amounts to quite a tidy sum, particularly if the structure is a standard which is employed frequently. By photographing the original drawings down to small scale and using prints from the negatives in the office calculations and field erection and to send to bidders a considerable reduction in expense is effected and increased convenience in handling and preserving the working plans in the shop and field is secured. It is obvious that this practice which has proved so successful with the Northern Pacific Ry. bridge department is likewise applicable to other departments of railway work, and indeed, to a very large class of drawing office work. Small blue-print photographs of standard track, switch and cross-over layouts, trestles, track signs and similar constructions can be mounted and preserved by foremen and superintendents for daily use with a very great increase in convenience and durability over the ordinary blue-prints. This fact has been realized by manufacturers who use photographic prints in their general office and shop work quite extensively, and some few railway companies have adopted the same practice. It is, however, a practice worthy of much more attention from railway engineers and motive power officials than it has yet received, as is evidenced even by the isolated experience of the Northern Pacific bridge department.

The promotion of Commodore E. O. Matthews, Chief of the Bureau of Yards and Docks, to the grade of Rear Admiral, and his possible assignment to the command of the Pacific Station, as indicated in Washington news items, will create a vacancy in the head of the bureau mentioned, and we may expect some interesting developments in the filling of that vacancy. Commodore Matthews has held the position named since March 16, 1894, and while he is a worthy line officer of the Navy, the question of his fitness for the intelligent and sufficient administration of a purely technical bureau has more than once been raised in this journal. As the opportunity is now presented for a change in the methods of heading this bureau it is to be hoped that Secretary of the Navy Long will take a business-like view of the situation and greatly strengthen his Department by placing a civil engineer at the head of the one civil engineer corps of the United States Navy. To all except the line officers of the Navy, who seek the position simply as a position and under the shadow of usage, or rather the abuse of an inherited succession, the advantages of the change in administration suggested are self-evident. The defective dry-docks at New York and at Port Royal have occupied much public attention of late, though it is not generally known that in both of these works the advice of the engineers, founded upon practice and experience at other points, had been overruled by the non-technical Chief of Bureau. Some of the defects now giving rise to serious trouble and costing the government a great and unnecessary outlay, had their origin in an honest attempt to economize in the cost of these docks by avoiding features of construction covered by patents in the hands of other builders. Economy in administration is always to be commended; but common business policy also requires that this economy should be tempered by a full and intelligent understanding of all the controlling structural conditions and the probable effect of false economy. Government dry-docks are built for use, and especially for emergency use, and it is little to the credit of our Navy Department that they should fail when most needed, as is the case at present. We, therefore, most respectfully submit to Secretary Long the urgent necessity and the business expediency of placing the administration of this technical bureau in the hands of an experienced civil engineer; even if this radical departure from the methods of his predecessors should rudely overturn all the traditions of the Navy. The precedent for such a ruling is to be found in the practice of the English and Continental naval establishments, and in the heads of every other technical bureau in the United States Navy—except the Bureau of Yards and Docks alone.

While not exactly pertinent to the subject of a suitable and proper head for the Bureau of Yards and Docks, we cannot refrain from calling attention to a direct violation of the Navy Regulations in connection with the late examination of candidates for vacancies in the Civil Engineer Corps of the Navy. Article 1,704 of these Regulations reads as follows:

> (1) Boards for the professional examination of officers for promotion shall consist of not less than three officers, senior in rank to the officer to be examined, and they will when practicable, be selected from the same corps as that to which the candidate belongs.
>
> (2) The mental, moral and professional examination of candidates for appointments to fill vacancies in the lower grades of the medical, pay and other staff corps, not filled by graduates of the Naval Academy, will be conducted by boards similarly constituted.

In the examination referred to, and which was for the selection of a civil engineer to fill a vacancy in the Civil Engineer Corps of the Navy, and for no other purpose, we learn that a board composed wholly of civil engineers was denied. The board

actually conducting this examination was headed by a Captain, a line officer, in direct violation of Naval Regulation 1,704 as applied to examinations for staff appointments. It would seem that a sense of self-respect would naturally prompt any officer of the United States Navy to decline service upon a board where the character of the examination was so entirely foreign to his own profession and outside of his own education and experience. It is to be exceedingly regretted that the only explanation for such a direct defiance of the law as laid down is to be found in the fixed determination of the line officers of the Navy to dominate in all things, and especially in the selection and the control of civil engineers. All these demands are made in the name of discipline, as fixed by the traditions of a navy no longer existing anywhere in the world. But true naval discipline now means a radical subdivision of duties; with one in supreme command; but with each division headed by the officer best fitted to direct and responsible only to the chief of all. With this law properly applied we would hear no more of line and staff bickerings.

THE REPORTS OF THE INSURANCE EXPERTS UPON THE PITTSBURG FIRE.

Whatever else may be said of the great fire at Pittsburg, Pa., which destroyed some $3,000,000 worth of property on the night of May 3, it has at least served one good purpose in arousing a pretty extensive discussion respecting the efficiency of modern fireproofing systems. In another column of this issue we give quite fully the reports of the appraisers appointed to determine the damage done to the fireproof store and office buildings owned by Joseph Horne & Co., and summarize more briefly the reports made to their respective concerns by Mr. S. Albert Reed, Manager of the Tariff Association of New York, and Mr. John R. Walters, Attorney and Manager of the Individual Underwriters' Association of Pittsburg. With the very full description and discussions of the fire which Engineering News has published, our readers are already familiar, and they need only be mentioned here. Altogether the different investigations which have now been made present a mass of evidence regarding fireproof buildings and their behavior under intense fire which should result in a general improvement in designing and erecting such structures. We have already considered this feature of the Pittsburg disaster at length, but some of the statements in these reports of the insurance experts seem entitled to further notice and, in one or two instances, we think, they are deserving of criticism.

So far as the reports may be accepted as proof, they indicate first of all that no radical change of policy will be adopted by the insurance interests toward fireproof constructions on account of their rather disastrous experience in this conflagration. As a result of the experience gained it is quite probable that insurance rates will be increased somewhat on certain classes of fireproof building risks, but this seems about all the modification that may reasonably be anticipated. It will be noticed that the appraisers' committee of engineers distinctly recommends such a policy in the closing paragraph of its report. Unless very great discretion is used in carrying out such a recommendation it seems to us, however, to be likely to prove a hardship upon many owners and builders which is not deserved. It is by no means agreed upon by disinterested engineers, notwithstanding all the evidence which we now have regarding fireproofing systems, which of them is the best, when all the factors of fireproof building construction are considered. We do not believe that this committee itself would care to assume the responsibility of scheduling each one of the score or more of fireproof floor systems, not to mention partition and column protections, in its proper place as to fireproofness, cost, ease of construction, lightness, strength, and half a dozen other qualities, all of which are desirable in a fireproofing material.

The criticism which has been showered upon the Board of Examiners of the Building Department of New York city is a pretty good illustration of the manner in which any arbitrary action in assigning the degree of excellence which a system of fireproofing possesses is treated by engineers, and also of the injustice which may be done to meritorious constructions by such action. It is worth while to note in this connection that the very class of construction which the appraisers' engineers recommend as best is the one which the New York Board of Examiners has persistently "turned down," and that the terra cotta construction which failed in the Pittsburg fire has had the faithful support of the Board of Examiners.

While the advisability of defining arbitrarily the merits of individual constructions is doubtful, it may be entirely possible that a distinction can be drawn between certain broad classes of fireproofing material. To our mind a still more profitable field for development would be in enforcing a uniform rule for putting up fireproofing and strict specifications governing the quality of the material of each class which will be recognized by insurance interests as qualified to receive their best rates.

It may be noted in passing this point that in a part of the appraisers' report which we do not print the two appraisers, who are themselves contractors, give considerable space to a defense of contractors who are sometimes obliged to put up poor fireproofing in a poor manner, because the builders will not pay for anything better. This defense is somewhat unnecessary, but it points out a way in which insurance companies can bring a pressure to bear which will secure good and safe work where engineers and architects are unable to do this.

From the report of the appraisers it will be seen that the salvage on the clay tile fireproofing in the Horne store is given as 16⅔%, and in the Horne office building as 66⅔%, not including partitions. The loss on partitions in the office building was 43% of the entire cost. It will, we think, strike most of those who examined the ruins of the store building that this figure of the saving in the fireproof protection, small as it is, is quite as large as its condition warrants. In our editorial of May 20, based upon a personal study of the ruins, we expressed the opinion that practically all of the steel frame would have to be dismantled of its fireproof coating, and it will be noticed that essentially the same opinion is expressed by Mr. S. Albert Reed in his report to the Tariff Association of New York. We would call attention in particular to Mr. Reed's remarks concerning the behavior of the floor arches in the Horne store, and recommend them to the consideration of those who recognize only brick and clay tile arches as fireproof floor systems. It will also prove interesting to note at the same time what the appraisers' engineering committee has to say upon the subject of concrete floors.

In some respects it is to be regretted that Mr. Reed did not make his remarks upon floor arches a little more clear. While it appears probable from the context that his statements relate to hard tile floors of side construction only, yet they may be understood as referring to all fireproof floor constructions. The failure of the floor arches in the Horne store is, of course, no valid reason for assuming that different floor arch constructions would have suffered equally bad failures under the same conditions. Indeed, the relatively excellent action of the porous terra cotta arches in the neighboring Horne office building, and particularly the concrete arches in the Methodist book building effectively disproves any such idea.

When compared with the remarks respecting the floor construction, the unreserved praise with which both Mr. Reed and the appraisers speak of the action of the steel framework of the Horne store in this fire should be particularly gratifying to engineers. The appraisers give the total loss on the steel-work as 16⅔%, but think that if it had not been for the falling of the water tank the loss would not have exceeded 5%. In regard to the supposed hazard from expansion, warping and twisting of metal framework due to great heat, Mr. Reed, it will be seen, thinks it is disproved by the experience at Pittsburg. The appraisers' engineers, on the other hand, point out quite clearly that expansion and contraction did take place, and express the opinion that had the structure been 14 or 15 stories high, instead of 6 stories, it would have been necessary to take down all of the framework. This opinion is directly in line with the one expressed in our issue of May 20, upon this point, although it is considerably more radical a one than we should be inclined to assume.

The engineering committee, as will be noted, lays considerable stress upon the wrenching of the steel frame by the fall of the water tank and other debris which it carried down. May it not be possible that this accident also accounts to some extent for the distortion of the framework? The committee's report also shows that such expansion as took place did very little, if any, injury to the riveted connections. This being the case, the committee was doubtless warranted in assuming that the variation of 2 ins. from the vertical, which the columns and one wall showed, presented no reasonable grounds for dismantling the framework. Just what phase the expansion would have assumed if there had been six more stories on the top of the Horne store it is difficult to say, but it does not seem to us quite certain that the distortion would have been enough greater to warrant the steel-work being taken down. Obviously the damage would depend much upon the character of the construction and the intensity of the fire in the upper stories.

It should not be inferred from what is said above that we consider the distortion of a steel building skeleton as a matter of no moment. It is evident to any one that the more nearly such work can be made to conform to the lines of the engineer's design, and the closer it can be kept in that position, the better it is. We also assume that the best kind of fireproofing and every other precaution should be taken to secure the integrity of the frame. The fireproof construction of the Horne store was very weak in the exposure of the attic columns and beams, and the easy access of flames to them through the elevator and light shafts.

These shafts, the want of partitions and the unprotected windows, however, belong to protective constructions against fire rather than to fireproofing in its more limited meaning, and we shall say something about them further on. We mentioned above the lack of fireproofing in the cockloft or attic. It will be seen that the appraisers' report speaks of the inadequate fastening which secured the tile plates to the bottom flanges of the beams. The fastening described, which is a common one, is structurally weak, whatever may be the excellence of the protective material used, and it has been proved to be so more than once. Another structural detail which is very commonly used is the placing of fireproof partitions on a strip of board as a base, and it is of importance to notice that the appraisers put the responsibility of the failure of the partitions in the Horne office building upon this construction very largely. Even without the board base these partitions, being only 4 ins. thick, did not have sufficient lateral strength. The improvements to the column protection and floor arches which are suggested in the appraisers' report are evidently wise ones. It is generally admitted that porous tile is better than hard tile, and that end construction is better than side construction. That column tile should be well bonded and firmly attached to the metal is self-evident.

Next to their remarks concerning the effects of the fire upon the purely structural parts of steel and tile buildings the various reports are particularly interesting for what they say about the value of fireproof shutters as protections against exposure fires. The appraisers and their engineers, it will be seen, speak very favorably of these protections; but the two insurance experts take a contrary view. Mr. Reed, the Tariff Association's expert, it is true, condemns shutters by innuendo merely, but Mr. Walters, of the Individual Underwriters' Association, is quite outspoken in his preference for outside sprinklers as being both cheaper and more effective than shutters. From any evidence which the Pittsburg fire furnished it is not quite plain why the last-named gentleman should take the position he does. As far as we know, outside sprinklers have nowhere proved their practicability as barriers against exposure fires, large or small. This at present cannot be said of fireproof shutters. There is no doubt that if a thick enough sheet of water is kept falling between the front of a building and a fire across the street it

will prove an effective barrier against the passage of flames, but with a fire having an intensity of that in the Jenkins grocery store, with its floors crammed full of lard, molasses, hams and other inflammable articles, it would take a good-sized cascade to do it. Such a volume of water is not always available in addition to the supply demanded by the fire engines, even if the construction of sprinklers to apply it effectively is admitted to be an assured fact, and this, we think, cannot be admitted except with very great reservations.

On the other hand, it must be acknowledged that the fireproof shutter constructions which we have are not all that is to be desired. Such as they are, however, they have proved very efficient protections in a number of fires, among which the Pittsburg fire itself is not the least notable. The iron clad wooden shutters at the rear of the Horne store withstood, as we stated in our issue of May 20 (and, it will be noted, that the statement is confirmed by the appraisers' report), a pretty intense heat, and effectively prevented the communication of flames to the adjacent wooden building. Similar shutters, it is true, could not have been applied to the front of this building, but that by no means proves that others could not. For example, we see no reason why, without any great change in the design of the box-girder window lintels, a rolling sheet shutter could not have been applied to every window at a reasonable cost. When rolled up between the girders such shutters would not have been noticeable, and when down they would have been pretty efficient barriers alone, and with the firemen on the inside to keep them cool with their hose streams we believe the flames would never have entered the store.

It seems to us that it is altogether too often taken for granted without question that shutters cannot be applied to a building without more or less injuring its appearance or its value as a show place for merchandise, when a very little foresight and study in the first design of the walls and window openings will satisfy both of these conditions and give the additional protection of shutters as well. This remark is equally true respecting the closing in of elevator shafts and stairways. It is likewise assumed that business considerations for some reason prohibit the use of partitions in large dry-goods stores like the Horne store in Pittsburg. Why it should be so assumed we have never seen any good explanation. It is seldom that these large floor areas are not divided as far as communication and sight are concerned by rows of shelving and counters for the display of goods. In part at least fireproof partitions could be placed where these stacks of shelves are and neither the customers nor the employees of the store suffer any noticeable inconvenience. On the other hand, the easy spread of flames would be greatly restricted by these partitions.

In the fever of steel and burnt clay building construction which seems to have seized upon the public, the older precautions in building to resist fire are very likely to be set aside as antiquated or no longer necessary. In a measure this is perhaps justified, but in a much larger measure it is a mistake. The Pittsburg fire is a very good proof of this by itself, but it is only one of many fires which have shown the same thing. It must be clear to any one that putting up a steel frame and covering it with clay tile, plaster of Paris, concrete, or any other protection, only gives us at the best a building which will not burn by itself. If we leave out all partitions and connect every floor by stairways, light shafts and elevator wells, and then pack the whole structure full of combustibles it becomes merely a huge stove, which may be injured by fire or not according to the intensity of the heat which the contents can generate. The Horne store was not only just such a stove, but it had its front open ready for the application of the torch. The old brick and wood Jenkins grocery, with its tons of grease and sugar, was the torch. With the kindling ready and the torch burning briskly, fire was started in the stove, and the stove could not stand the heat. We desire to see the best systems of fireproofing adopted and used, but we imagine that most engineers will agree with us in holding that there are other things which need looking after far more than the quality of fireproofing if stocks of goods in stores and warehouses are to be made secure against fire risks.

LETTERS TO THE EDITOR.

Printer's Ink on Tracing Linen for Blue-Prints.

Sir: In your issue of June 24, I notice an article on the use of printer's ink in printing titles on tracing cloth, and the consequent delay occasioned in drying. I have been using printer's ink for the past three years, and in that time have put titles on more than 6,000 tracings, printing as many as 60 or 70 a day. For the benefit of those who may have occasion to handle many tracings, I will give our method of drying the ink.

We use ordinary black book ink, price $1 per pound. After printing the title on the drawing, take a small camel's-hair brush and with it spread a little powdered soapstone over the ink. In five seconds the ink completely dries. The soapstone can be procured at any large drug or shoe store, and the best results are obtained by using the rough side of the tracing cloth.

Very truly yours,
Ray Stewart,
Title and Blue-Printer.

The Penna. Steel Co., Street Railway Dept., Steelton, Pa., June 30, 1897.

A Competitive Test of the Cazin and Pelton Water Wheels Wanted.

Sir: Having read with much interest the correspondence in your issue of June 24 from Mr. F. M. Cazin and Mr. Dorville Libby, Jr., in regard to the relative merits of the water wheels made by the American Impulse Co. and the Pelton Water Wheel Co., I feel that I shall voice the wishes of a number of fellow engineers in suggesting that a practical competitive test of the two wheels be made. Such a test would decide the question at issue better than anything else, and I think that the results would be awaited with much interest by the profession. Let each company back its judgment and may the best man win.

Dubney H. Maury, Jr.

Peoria, Ill., July 10, 1896.

(We suggest that any such test might well include the other impulse wheels on the market, such as the Cascade wheel of the James Leffell Co., of which tests were reported in our issue of July 8.—Ed.)

An Increase in the Length of the Coping on the Mohawk River Aqueduct, Erie Canal.

Sir: I send you several photographs and a blue print showing the movement in the coping of the Mohawk River Aqueduct, on the Erie Canal, at Crescent, N. Y. This structure was commenced in 1838 and completed in 1842, under the late William J. McAlpine as engineer. It has a total length of 1,137 ft., and is founded upon rock, so that no settlement of consequence has occurred.

The plan submitted shows the extent to which the coping has moved, over a distance of 528 ft., taken each way from a center point. The projections in the coping are located on the buttresses shown in the photograph. It will be noted that the coping over the center-buttress is not in its original position, and that the center of motion of the whole coping is north of the center of the aqueduct. The original projection may be found by taking the average of the present projection on each side of the buttress; or 3 9-16 in. + 2⅝ in. ÷ 2 = 3⅛ in. The total motion on the south end is therefore 12 — 3⅛ = 8⅞ in., on the north end it is 9 — 3⅛ = 5⅞ in.

The photographic view shows the coping north of the center of the aqueduct, where a whole stone has been raised bodily from the parapet and is wholly supported by the pressure on its ends. A streak of light can be seen under the stone and some of the adjacent stones are badly disintegrated and show signs of crushing. This coping is made of cut limestone, and they have many dowel holes in the top, filled with cement; but no dowels can be seen where the stone is lifted from the wall.

The behavior of this coping is a local curiosity, and I have been unable to find an account of any similar occurrence. It has been suggested that the motion may have been caused by the freezing of water in the joints; but the pressure necessary to crush the ends of cut limestone blocks would probably liquify ice, or cause it to expand in the plane of the joint, rather than to exert a thrust sufficient to move the stone in the line of the aqueduct. It has also been suggested that the effect was due to expansion under temperature changes. While this is plausible, the explanation is not wholly satisfactory. The coping is cut from local limestone; and assuming it to expand at the same rate as dry white marble, or 1 in 173,000 parts per degree of temperature as given by Trautwine, the expansion for 100° F. in 528 ft. would be 3⅜ in. But the minimum expansion from the center is 5⅜ in., or 2 in. more than the above; and the maximum expansion from the center is 8⅝ in., or more than twice the calculated expansion. Further than this, if the effect is due to temperature changes, the stones should contract in winter as well as expand in summer. But the stone shown in the photograph remains suspended throughout the year; and on March 8 last, with the temperature at about 32° F., I examined the coping and found every joint perfectly tight, save for a distance of about 50 ft. at the north end. The joints varied in thickness from nothing to about ⅛ in., but they were so tight that a knife blade could not be inserted between the blocks. To all appearances the coping has grown about 14 in. in length.

On the Upper Mohawk Aqueduct there is a similar lifting of the coping, and the same thing has occurred in the retaining walls of the West Shore Ry., at Amsterdam and Fort Plain. In these cases no longitudinal motion can be measured, and the movement is only indicated by the lifting and crushing of several pieces of coping. I trust that some one more familiar with similar occurrences will explain this movement.

Yours truly,
Albert G. Himes, Assoc. M. Am. Soc. C. E.

Albany, N. Y., June 1, 1897.

CONDENSED PLAN OF COPING OF LOWER MOHAWK AQUEDUCT, ERIE CANAL, SHOWING POSITION OF COPING STONES AT END AND CENTER WITH RESPECT TO THE BUTTRESSES BENEATH.

Exhibitions of Chemical Fire Extinguishers.

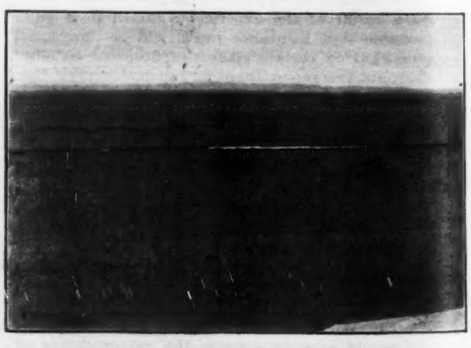
Sir: Apropos of the account of a test of a new chemical fire extinguisher in your issue of July 8, I would suggest that there is a great deal of misconception regarding the public exhibition of many of the "hand grenades," "fire bombs," etc., offered the public. It is customary to prepare in some public place a small building saturated with kerosene or other quick-burning compound, ignite the same, and, after the whole mass is fiercely blazing and alive with glowing coals, to apply the extinguisher. Usually the result is successful. The great heat volatilizes some of the salts present in the extinguisher compound, which same shuts out the oxygen and thereby reduces or entirely stops the fire.

The error in judgment uniformly made by the spectators of such an exhibition is that if the preparation can stop so fierce a blaze it could surely deal with a small, insignificant fire.

In this assumption they are altogether wrong. The heat of the fire must be sufficient to volatilize the salts present in the fire-extinguishing compound, or else little good can obtain from their presence. In other words, one must stand, with the grenade in hand, until the fire is well under way before employing the remedy. Would it not be better to call the fire department or use a bucket of water at an earlier moment?

Wm. P. Mason.

Troy, N. Y., July 10, 1897.



View of a Coping Stone Raised from its Bed and Supported by End Pressure.

(We regret to be compelled to differ with so excellent an authority as Prof. Mason. We have seen the dry powder extinguisher referred to in the note in our issue of July 8, used to extinguish very small fires, where only flame and no coal

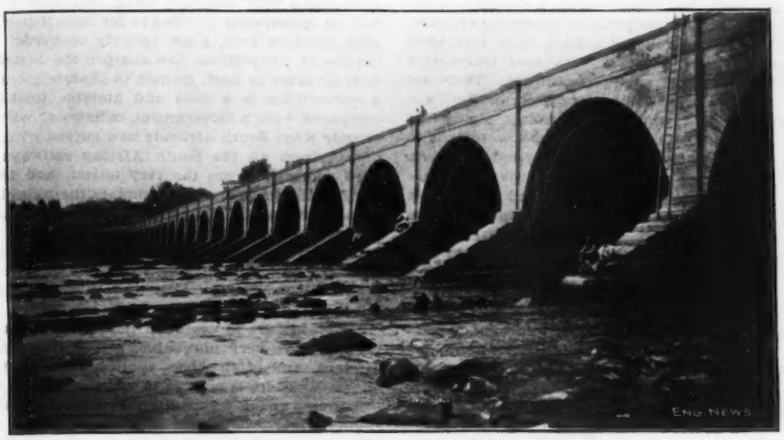
was present, and it worked perfectly. Apparently, in this case at least, no very great degree of heat is necessary to liberate the gases which smother the flame and extinguish it.

The "hand grenades" to which Prof. Mason refers are, we believe, much less efficient than some of the later styles of chemical fire extinguishers, in which a chemical solution, or in this case, a dry powder, is directed upon the fire.

Members of the staff of this journal have witnessed a large number of such tests, and we are inclined to criticize them generally on quite different grounds from those mentioned by Prof. Mason. His description of the nature of the exhibition test usually made is substantially correct; but it will be noticed in very many tests that the last thing done before the torch is applied is to throw a pailful or so of naptha, benzine or kerosene over the surface of the woodwork exposed to the open air. This blazes up in a great mass of flame almost instantly when ignited, and is allowed to burn for a minute or so before the extinguisher is applied. By this time there is very little left to burn save the woodwork, and this would make by itself not a tenth or a twentieth as much flame as that from the volatile liquid. The extinguisher is applied just at the moment when the exhibitor notices the flames begin to fall, so that the disappearance of the flames is partly due to the exhaustion of the combustible, as well as to the smothering by the gases which the chemical gives off.

But when all allowance is made for this effect, we are obliged to conclude from our knowledge of the action of this class of chemical fire extinguishers in inexpert hands, as well as in exhibition tests, and on both large and small fires, that they are an exceedingly important improvement in fire-fighting appliances, and worth much more attention from engineers, manufacturers and others than they have thus far received.

It appears to us, moreover, that Prof. Mason, or some other man in charge of the chemical laboratory at some of the engineering schools, could do a real service to the profession by analyzing and testing some of these chemical fire-extinguishing compounds, determining the nature and volume of the gases given off by them when heated, ascertaining whether any gases possessing noxious properties are given off, and getting the whole matter into such shape that an engineer could write a specification for an equipment of chemical extinguishers for a factory or other building, and could have some assurance as to the quality of the material which he received.—Ed.)



GENERAL VIEW OF LOWER MOHAWK AQUEDUCT, ERIE CANAL.

SOUTH AFRICAN RAILWAYS.

By F. W. Wilson, C. E.

Although the writer's business interests in South Africa have been in a measure, at least, foreign to such channels as would afford facilities for a thorough and intelligent study of the railway systems of this country, yet it would be strange, indeed, if the habits of observation formed by some years of connection with railway engineering works in the United States should fail to impress upon him some of the peculiar features of the South African railway systems. Some of these systems are of impressive dimensions, but all are most infantile in development as regards the many luxuries, conveniences and safety appliances to which Americans have accustomed themselves.

The principal systems at present in operation are the Cape Government Railways, the Natal Government Railways and the Netherlands Railways. The Cape Government Railways are the largest as to mileage, and may be taken as a representative type of the South African railways, with the single exception of the Netherlands Railway. The latter is owned partly by the Transvaal Government and partly by private parties, who are concessionaires of the Government, and the result is that it possesses many peculiarities which distinguish it from the other systems. This difference is due to the fact that its management and its equipment are derived principally from Holland. But of its distinguishing features I will say more later.

Referring to the Cape Government Railways as embodying the standard features incident to the colonial English railways in this country, I will offer the following description, with some mention of the Netherlands Railway as well:

The topography of the portion of South Africa traversed by the Cape Government Railways may be briefly described as follows: Beginning at Cape Town and extending in a northwesterly direction to the Zambesi River, is a high plateau, level for the most part, but broken in places by mountain ranges rising above the general level, and dotted with innumerable "kopjes" (hills or mounds). Capetown, the starting point of the Cape Government Railways, is located on a sloping bit of plain which extends from the shores of Table Bay to the foot of Table Mountain.

Table Mountain rises above the city a sheer precipice 3,500 feet high, and its top, which is almost perfectly flat, is in general altitude about the same as the table lands which, though broken by ravines and peaks near Capetown, gradually become formed into a vast plain extending, as before stated, to the Zambesi River. This plain is the "karroo," familiar, in name at least, to all who have read of South Africa. The only engineering difficulties presented in the location of the Cape Government Ry. were such as were encountered in the ascent from the sea level to the top of the table land. From there to the Vaal River in one direction and to Kimberly in another it traverses a country so similar to our western plains or to parts of Mexico that there is no difference which the eye may detect. The vegetation on the "karroo" is to all outward appearance the familiar "sage-brush" of our Western states.

The cactus also appears, but in a more dwarfed state. The scarcity of water and the generally bleak, uninviting appearance are all familiar to the American who has been through Nevada, New Mexico or Arizona.

The Orange Free State alone presents a different aspect. Here we have rolling, grassy plains, which remind one forcibly of some portions of Texas, and the eye is relieved from gazing on the barren "karroo" to looking across the fresh green of the undulating prairie, for the grass of the Orange Free State is green even in the midsummer, as the rainy season is during the midsummer months of January and February.

The cost of constructing a railway through the "karroo" and the verdant plains of the Orange Free State is a minimum so far as actual work of construction is concerned, but when one stops to consider that all the plant and equipment must come at least a distance of 6,000 miles by steamer, and that it is located through an utterly barren desert so far as timber is concerned, it may readily be imagined that the cost per mile would exceed some of our heaviest construction in the United States.

The gage of all the South African Railways is 3 ft. 6 ins., and there is at present no tendency, so far as I can learn, toward a wider gage. But it is no doubt a matter which will eventually come to the attention of the officials with the results already seen in other older railway building countries.

The roadbed is, generally speaking, all that one could desire, as rock for ballast is abundant and native labor in the colonies is fairly cheap. The cross ties are mostly wooden upon the Cape Government Ry., although steel ties have been used on some portions of the road. The steel ties are mostly of pressed steel, and the rails are secured by clips and bolts on the European system. The rails are of light section, but are abundantly heavy for the class of rolling stock used. Even the wooden ties are imported, the one great need of South Africa being a supply of timber available for structural uses.

The water tanks are chiefly of steel and are simply rectangular boxes set upon trestle towers or masonry foundations. Iron bridges are in use wherever stone culverts will not provide an economical waterway. The type of bridge truss which is invariably used is a double intersection triangular truss, with riveted joints. The trusses are nearly always low, and in some cases the two trusses are tied together by joining the top chords by a curved strut. This is a favorite scheme of English bridge designers, and the folly of such designs has been pointed out in more than one instance in the columns of Engineering News.

The stations are almost all stone buildings, with corrugated iron roofs, and even small stations are of elegant design and substantial construction. At many stations no other building is in sight. The name of the station is set forth by an enameled sign, with white letters on a blue background, which has a very familiar look to an American railway man. The freight sheds at the more important stations are constructed by building a wooden frame and covering it with corrugated iron. The shops of the Cape Government Ry. at Capetown are substantial brick buildings, with the exception of a few minor buildings. The station at Capetown may be said to be an exact likeness to the Grand Central Station in New York city, except that it is on a smaller scale and the waiting rooms for passengers are omitted. One is supposed to take his place in the compartment and wait there for the train to start or else stand on the platforms.

Some of the rolling stock is, indeed, unique. The locomotives are of English design and construction, and are provided with a most ludicrous excuse for a whistle and no bell. As they seem to answer all purposes, however, there is no occasion to criticise their effectiveness. Two American locomotives have been recently put into service on the division running from De-Aar to Port Elizabeth, and if there is anything favorable said about them by the Englishmen in this country, I have yet to hear it. The noisy whistle shocks them, the assertive ring of the bell is displeasing, they won't haul the loads, they can't make the time, they burn more coal, they use more water; in short, they are no good. As to how much of this is prejudice and how much fact, I am utterly unable to say, but a

compliment to a piece of American machinery of any description is as hard to secure from an Englishman in Africa as it is said to be for the millionnaire to enter the kingdom of heaven. The passenger cars are of rather a mongrel breed. They are not such as I ever saw in any other country, and the makers have not seen fit to embellish them with an advertisement over the doors as is the custom in "the States."

They are in general plan very similar to the Mann boudoir cars which were run on the Cincinnati Southern Ry. at one time, and perhaps at the present time for anything that the writer knows to the contrary. There is no smoking compartment, but smoking is allowed in each and every compartment. Toward night a "guard" visits you and inquires if you "want a bed." If answered in the affirmative, he produces from parts unknown a dirty looking bag containing two sheets, a blanket and a pillow. He proceeds to make this into a "bed" in the upper or lower seat, as per your ticket or preference. The charge for this luxury is 5 shillings for the entire trip from Capetown to Johannesburg. This includes two nights' use. While these cars, known as "saloon carriages," are similar in plan to the Mann boudoir cars, it may be safely stated that the similiarity begins and ends right there. There has been no money lavished on adornments which might please the eye, either outside or inside. The seats are upholstered in leather, and are durable, but not picturesque. The woodwork is glaringly plain, and the discomforts are of a superlative order. The aisle which passes the different compartments and which affords the only means of entrance, exit or passage, are precisely fourteen inches wide by actual measurement, and it not infrequently happens that fat men become wedged therein and have to be pried out by sympathetic fellow passengers. The toilet rooms are of most lilliputian dimensions and are left to take care of themselves, with easily imagined results. One towel is provided in each wash room, and its condition after a 56-hour journey from Capetown to Johannesburg is a subject better imagined than described. The lighting is usually effected by huge oil lamps, which are stuck through holes in the top of the car. At certain stations along the line the lamps, whose supply of oil has been exhausted by the previous night's run, are exchanged for others freshly filled. This is managed by a gang of men, who throw the exhausted lamps from the top of the car into the hands of other men who stand on the platform and catch them. The freshly filled lamps are then thrown to the men on top, who deftly catch them and drop them into their respective holes in the roof of the car. Other more pretentious trains are lighted by electricity. The current is generated by an oil engine, which travels in a special car designed for it, and the engine is so large, in fact, that there is little room for the operator and other necessary adjuncts, such as the dynamo, etc. The electric light, as used on the Cape Government Ry., is certainly not a success, as it has a habit of going out just as you are approaching a crisis in an interesting book, and as a rule it will not appear again. If it once quits business for the night, that ends the matter and you may as well go to bed. If the oil lamps are in use there is no way to turn them down or put them out. They are sure to burn until the oil is exhausted, and a cap of green cloth is provided so that when you retire you can cover them up.

Most Americans have an impression that car heating would not be necessary in South Africa, but this is a mistaken idea. The nights, even in summer, are very cool, but in the winter (July and August) they are intensely and penetratingly cold, and the heating is accomplished by providing the passengers with tin cans of hot water to warm their feet and the other parts of the anatomy must be looked after by the passenger himself. In the morning the water in the can has turned to ice, and the inexperienced passenger is likely to find his feet almost frozen to it. But this is a purely English idea and one that they regard as embodying the most modern conceptions of comfort.

It is persistently adhered to on some of the English railways, and I have heard many Englishmen who had traveled upon our American railways object to the cars being too hot, and state that they preferred the English plan.

For my own part it savors too much of sleigh riding to suit my notions, as that is a sport I never cared to indulge in out of doors. I have, of course, been describing "first class" passenger travel, and up to the present time I have never had the temerity to gain any experience in "second class" or "third class" accommodations, and have no desire to experiment in that direction. It is rumored that the Pullman company have been making efforts to introduce their cars upon the Cape Government Rys., and I understand that a sample car is now being fitted up to be run on this road as an experiment. I hope this is true and that prejudice will not cause the public to favor the present disagreeable and poorly managed equipment. The cars I have been describing are referred to in the advertisements of the Natal Government Railways in some of their circulars as "American Saloon Carriages." They are certainly American in name only, unless they were manufactured there. This may be the case, as I have never learned where they are made, but it is certainly a discredit to our vast strides in the production of luxurious and convenient passenger coaches to liken these cars, even in name, to the luxurious vestibuled trains now running on our best equipped railways. There are other first class passenger cars used on the Cape Government Rys., which are exactly similar to those generally in use in England, the difference being that the compartments are entered by means of a door opening on the outside of the car. There is no toilet room, no wash room and no passage along the car, nor any means of passing from one car to another.

The freight cars for transporting machinery and goods of all descriptions are very short, flat cars on four wheels, and their appearance justifies the usual name of "wagons," by which they are known. These cars are covered by a canvas covering tied down at the sides, if goods are to be carried in them, but if sheep, goats and donkeys are to be transported, they are provided with a cover of netting, which is made of strong cords and fastened at the sides.

Some "box" cars are used for conveying cattle, horses and "niggers."

The baggage cars are usually provided with a compartment in one end for the mail. Sometimes a "guard" travels in the "luggage van," as it is called, and sometimes there is no one acting in this capacity. I have good reasons to regret this uncertainty as to the care of "luggage," from the fact that while traveling from Kimberly to De-Aar with my "luggage" confided to the usual "van," it chanced that an oil lamp turned over in the "van" and set fire to the car and its contents. As there was no guard present to extinguish the fire, it burned along merrily for some miles until the train was stopped at Orange River Station. The fire was then devouring the last of the mail matter and was approaching the "luggage." The railway employees stood around holding lanterns and watching the conflagration while the passengers frantically worked at rescuing the "luggage."

Finally the engine shifted the rest of the train and backed down and coupled on to the burning "van" just at a time when the passengers had succeeded in turning the water from an adjacent tank upon the fire. The engine was made to haul the burning car a half mile through a strong wind to a tank beyond the station. By this time the blaze had been fanned until it enwrapped the entire car and its contents. All chance of saving the luggage was now passed, and through the open door I made out my own name printed upon a trunk fast being consumed. This trunk contained all my price-lists, contracts, private telegraph codes, letters of introduction and letters of recommendation with which I had come to a foreign country, and I had to stand quietly by and watch it go up in smoke and flame. Some of the papers lost could never be replaced, and three months would have to elapse before those which could be renewed by copies would be obtainable. I relate this incident to show the lack of safeguards against such accidents and the utter incapability of the railway employees in an emergency.

In the matter of handling baggage, the South African railways are in advance of English systems, as they have a more or less perfect scheme of checking baggage. The checks are paper slips instead of brass tags, and in theory the plan is probably all right, but it frequently fails to operate correctly, as luggage often "strays" off into unknown parts and is never found.

The railway company usually settles such claims in from one to four months.

The writer brought suit against the railway company for compensation for the loss incurred by the fire at Orange River Station, and after three months recovered £88 14s. (about $435). It is fair to say that this is probably much more than could be recovered from an American railway under the same circumstances.

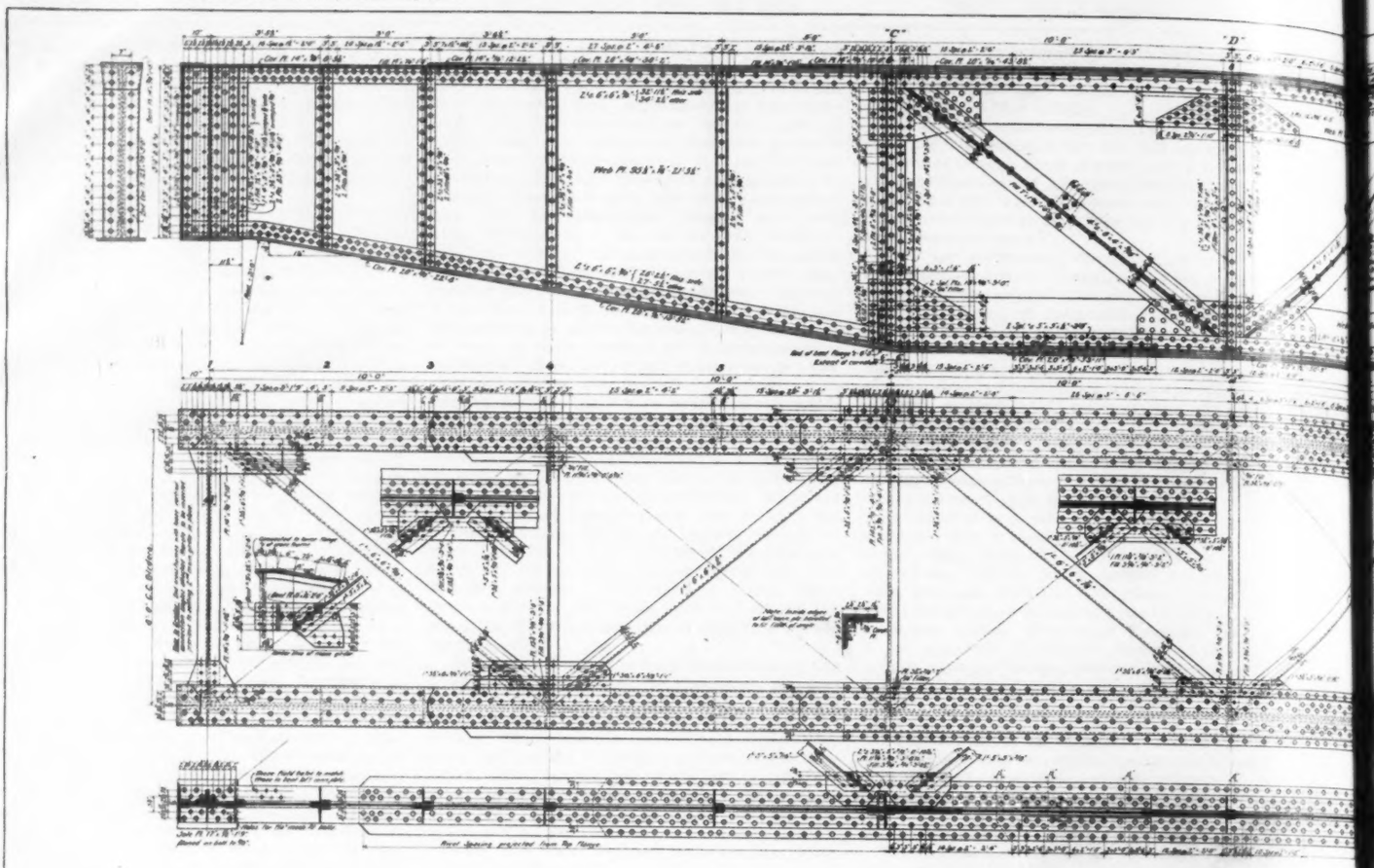
The Cape Government, through a special act of Parliament, is entirely exempted from the payment of any claims arising from the non-delivery or misinterpretation of telegrams. The telegraph lines, as well as the railways in Cape Colony and Natal, are owned and operated by the Governments, and I may remark just here that previous to my arrival in South Africa, I believed that Government ownership of railways and telegraph lines was a very desirable thing; but since I have had an opportunity to observe for myself how this plan operates here, I am entirely converted to a system of competition, the sharper the better. A railway trust or pool, formed to obviate too sharp a competition is a mild and amiable institution compared with a Government monopoly, which is exactly what South Africa is now cursed with. The profits from all the South African railways has been enormous from the very outset, and this is small wonder when we contemplate the freight and passenger traffics. First class passenger fare is 6 cts. per mile throughout South Africa, and freight, even of "undamageable class," is approximately 2 cts. per ton mile. The rate of speed for the fastest passenger trains is about eighteen miles per hour.

Air brakes are in use upon the passenger trains, but they are very unreliable, sometimes refusing to work, and often when applied, refusing to be released. There is no way in which to stop a train when once under way, except at the option of the engine driver.

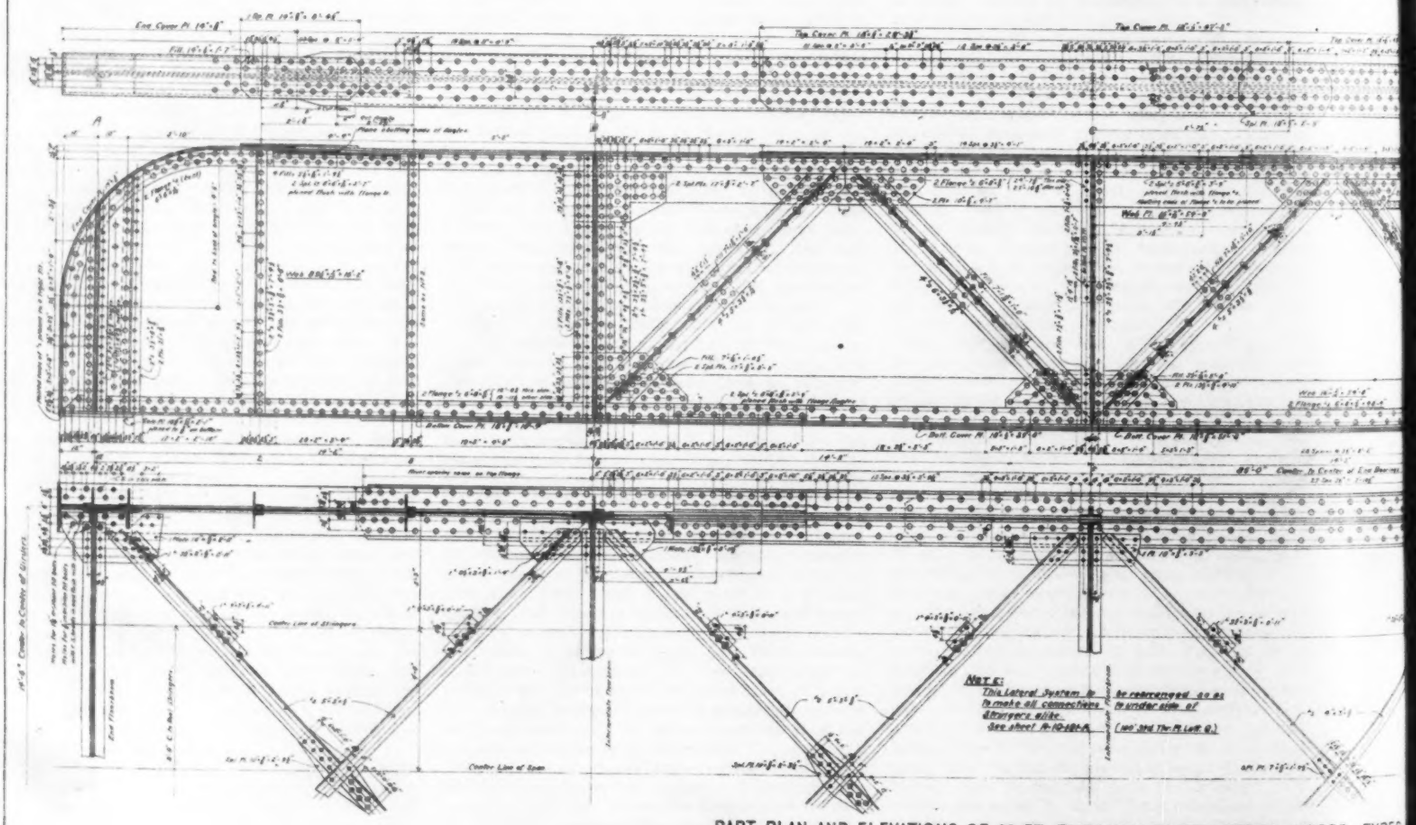
The familiar bell rope of our American trains is unknown in South Africa, and as there is no means of passing from one car to another, the situation is, indeed, serious for passengers in a derailed car or in case of an accident of any kind.

The Netherlands Railway's peculiarities have already been briefly referred to. The passenger cars are about half the length of those on the Cape Government Ry. They run on only four wheels and have better finished interiors. They also have a very convenient means of getting from one car to another, but this advantage is not so great as might appear, for the cars are coupled in pairs, and while two adjacent ends of a pair of cars are open for passage, there is not even a door at the other ends. To go through the train is therefore impossible. Many of the freight cars are built entirely of steel and some are of about 30 ft. length and carried on trucks at each end. The bridges and culverts are all substantial and permanent, the former being of steel and the latter of stone.

More steel ties are used on this system than on the Cape Government Rys. The line is almost completely fenced with wire fencing. The stations, freight sheds and engine houses are all of brick or stone, and are well designed and built. It is not the equipment of the Netherlands Railway that one can object to, but the management, which is open to the most severe censure. Goods are lost, broken, damaged and stolen with such regularity that one can never be sure of receiving a consignment in fairly good condition, even though after thousands of miles in transit it may be delivered to the Netherlands Railway in good condition. It does not appear to make any especial difference as to what the bulk of the shipment may be, or how useless it might prove to a thief, it can become lost on the Netherlands Railway just as readily as the smallest article. Three large steam boilers were lost between Delagoa Bay and Johannesburg and never found. Two car loads of lumber from Oregon were lost on the same journey and the consignee went to the officials to enter claim for damages. They looked the matter up and told the gentleman that he had not paid the freight. The freight amounted to three times the value of the lumber. It was decided, therefore, that it was cheaper to relinquish all claim to the freight than to pay three times its value and still have no as-



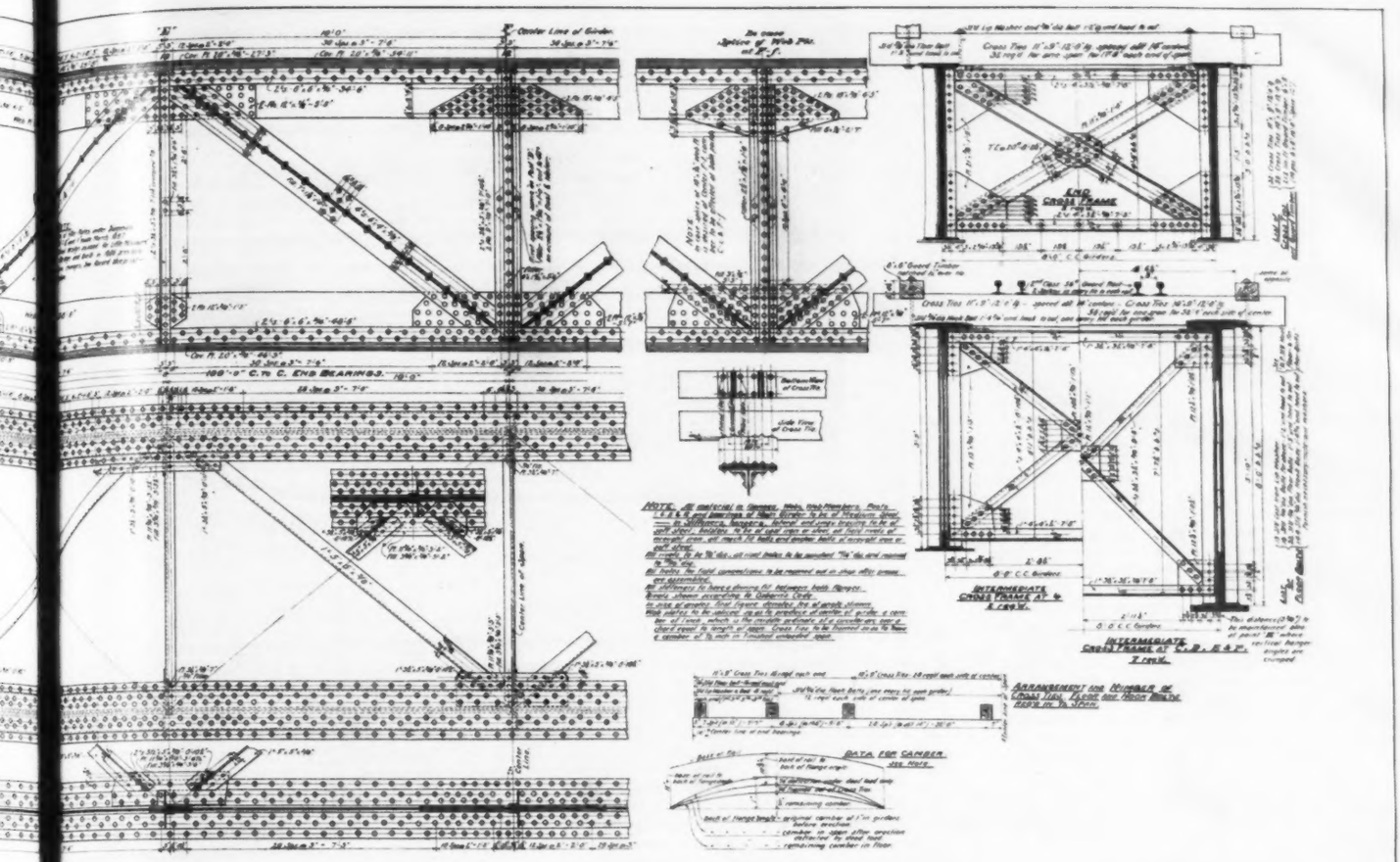
PARTIAL PLAN AND ELEVATIONS OF 100 [illegible] PI



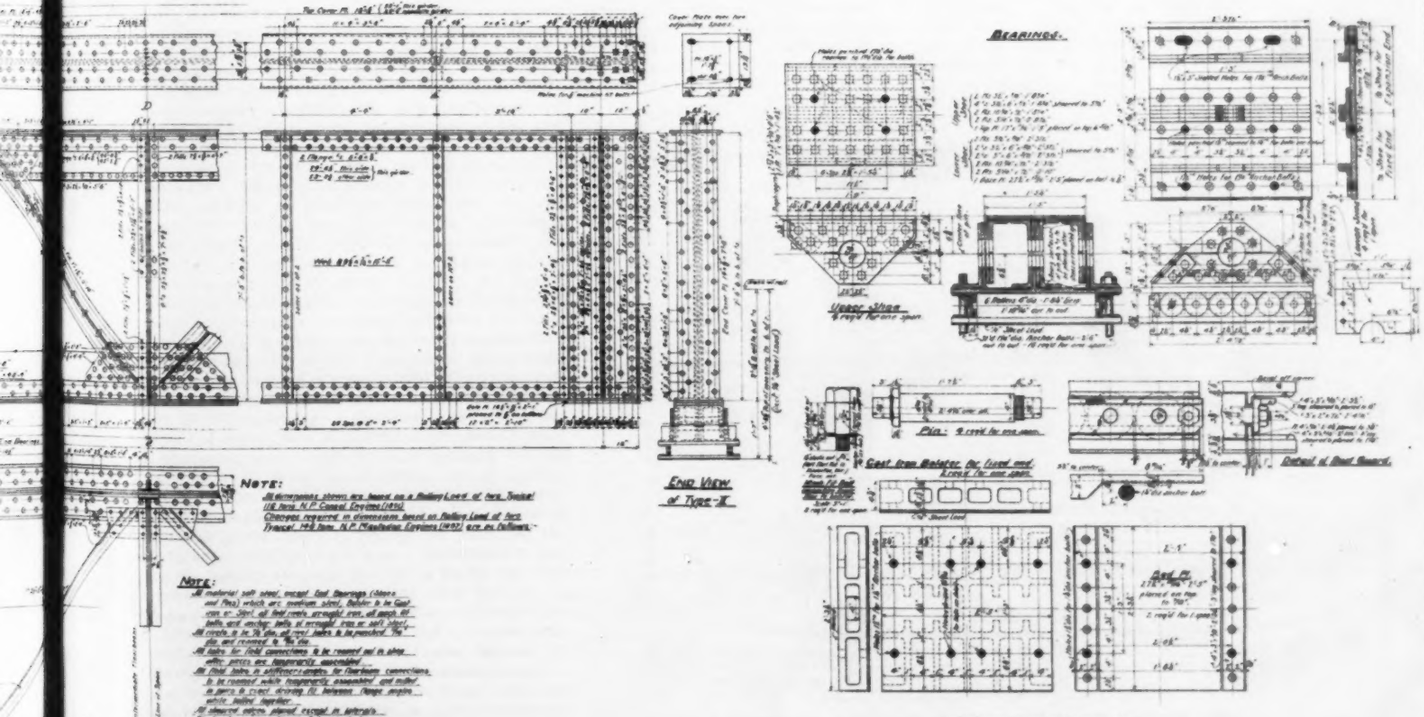
PART PLAN AND ELEVATIONS OF 85 FT. THROUGH PLATE-LATTICE GIRDER, TYPES [illegible]

STANDARD DESIGNS FOR G[illegible]ER

K. E. Hilgard, M. Am. Soc. C. E., Engineer of Bridges;



CK PLATE-LATTICE GIRDER, TYPE II.



DETAILS OF BEARINGS.

TYPES AND II.

ER BRIDGES, NO. PAC. RY.

E. H. McHenry, M. Am. Soc. C. E., Chief Engineer.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

surance that the company would pay for the loss, to say nothing of the slender chance of getting the charges refunded. The lumber has not been found up-to date.

One of the most peculiar actions of the Netherlands Railway management occurred in Johannesburg a few weeks ago. An assistant traffic manager was accused of stealing chickens and some other things which passed his way while in transit. He was retained in his position during the trial and was defended by the railway company's attorneys, and at their expense. Such a proceeding might elicit much criticism in some countries, but when one has become accustomed to the vagaries of the Transvaal Government one ceases to wonder at the proceedings of subordinate institutions. Whatever may be the shortcomings of the Netherlands Railway Company as regards the care and delivery of goods intrusted to them, no one can accuse the company of not earning dividends. Despite extravagance, ignorance and mismanagement, it manages to grind out dividends of 25% yearly, besides carrying on elaborate improvements of all kinds. The amount paid in dividends for the last fiscal year by the Netherlands Railway was $8,750,000. This is much more than all the dividends paid in the same period by all the mines in the Transvaal. One characteristic of the Netherlands Railway is the utter absence of suitable switching facilities. I have not so far discovered anything approaching a switching yard of any respectable dimensions, such as the traffic demands. Cattle have often been starved to death in coming from the Transvaal border to Jahannesburg, a distance of 50 miles, because of inadequate switching accommodations.

The salaries on South African railways are not such as would tempt an American of any considerable ability in any department of railway service. The Managing Director of the Netherlands Railway has a salary of $40,000 per year, but the subordinate positions are poorly recompensed. One very necessary requisite in order to obtain the most humble position on the Netherlands Railway is that the applicant be either a Boer or a Hollander.

Experience is not so essential, but the nationality must be as above or there is no chance. Almost the same state of affairs exists in the management of the English colonial railways, excepting that here the successful applicant must be either of colonial English stock or a native born Englishman. The salary of the Chief Engineer of the Cape Government Ry. is $6,500 per annum, and his principal assistants receive about $2,500 per year.

Considering the cost of living in South Africa, an American engineer would be better off in the United States with a salary of $1,200 per year than with double that income here. The entire English colonial railway systems are under strict civil service regime.

One curious and rather unpleasant feature of travel in South Africa at present is being "disinfected" at the border of Natal and Cape Colony. This is done in order to try and stop the spread of the "rinderpest," a disease which has killed almost all the cattle in every part of South Africa where it has made its appearance, and which threatens to complete the extinction of all the oxen in the country. As the wealth of the farmers in South Africa is measured by the number of oxen they own, and as all the hauling, freighting to interior towns, ploughing, etc., was done by oxen, it practically amounts to ruin to the agricultural interests to lose them. Therefore the English colonial governments are doing all in their power to stop the progress of the disease, which, in spite of their efforts, is still sweeping southward to the coast.

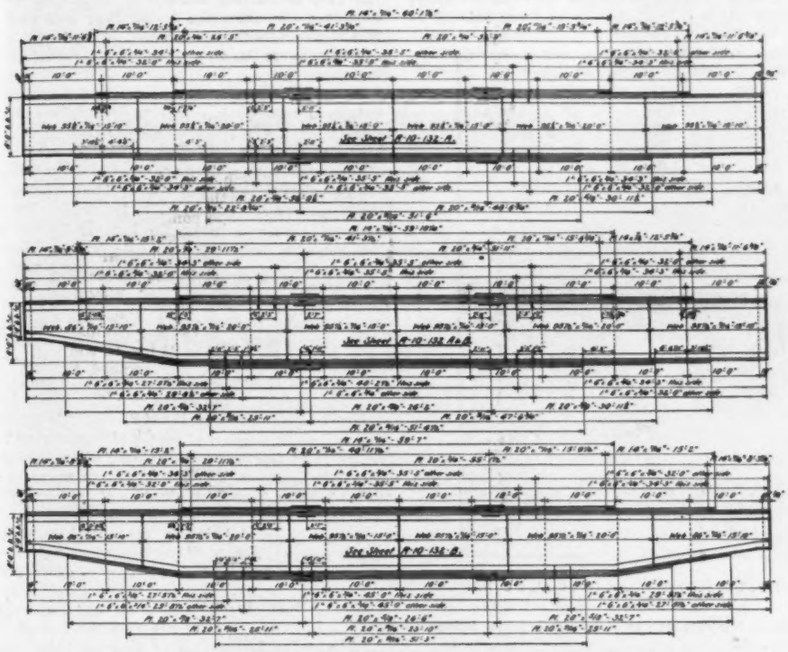



FIG. 1.—STANDARD TYPES OF 100-FT DECK PLATE GIRDERS, NO. PAC. RY.

As it has been proved that the germs may be transmitted in clothing and by bits of skins, leather, etc., or by dogs, it has become necessary to disinfect all passengers going south into the Cape Colony or Natal, and all skins, fur rugs, dogs, etc., must be seized and held at the border.

The disinfecting process as applied to passengers is effected in the following manner: The passenger is admitted to a small room, in which are several chairs, and after seating himself in a chair, a towel is wrapped around his neck, then a rubber hood is placed over the entire chair and enclosing the entire body, excepting the head.

A trap door is then opened and sulphur vapor is admitted under the rubber hood for several minutes. A part of it is sure to find its way into one's nostrils and the discomfort is intense, but there is no escape.

The hood and towel are finally removed and one must wash the face and hands in a basin and cleanse the finger nails.

After passing to another room a Kaffir washes the bottoms and sides of your shoes with a disinfecting solution and you are allowed to proceed to your seat in the train.

It must be admitted that the passengers endure this disagreeable treatment with the best possible good humor, and all are consoled with the thought that the intentions are of the best, even though the process may appear to be unnecessary in the case of many who have had no occasion to come into direct contact with oxen for months past, if, indeed, at any time.

In conclusion, I wish to emphasize my firm convictions that Government control of railways and telegraph lines is an evil which cannot be overestimated. I am confident that with some degree of competition in the railway service of South Africa we would have cheaper tariffs, faster trains, more modern cars, more safety appliances and more courtesy from the employees. At present if one complains of anything to a railway employee he is likely to be told that if he "don't like it, just get off and walk."

PLATE-LATTICE GIRDER BRIDGE OVER LITTLE MISSOURI RIVER, NORTHERN PACIFIC RY.

(With two-page plate.)

We gave last week an account of the interesting plate-lattice bridges which the Northern Pacific Ry. is building along its main line from the designs of Mr. K. E. Hilgard, Engineer of Bridges. We show this week on our inset sheet the standard designs prepared by Mr. Hilgard for 100-ft. deck plate girders and 85-ft. through plate-lattice girders, with details of their cross-bracing and bearings. The make-up of various types of 100-ft. deck plate

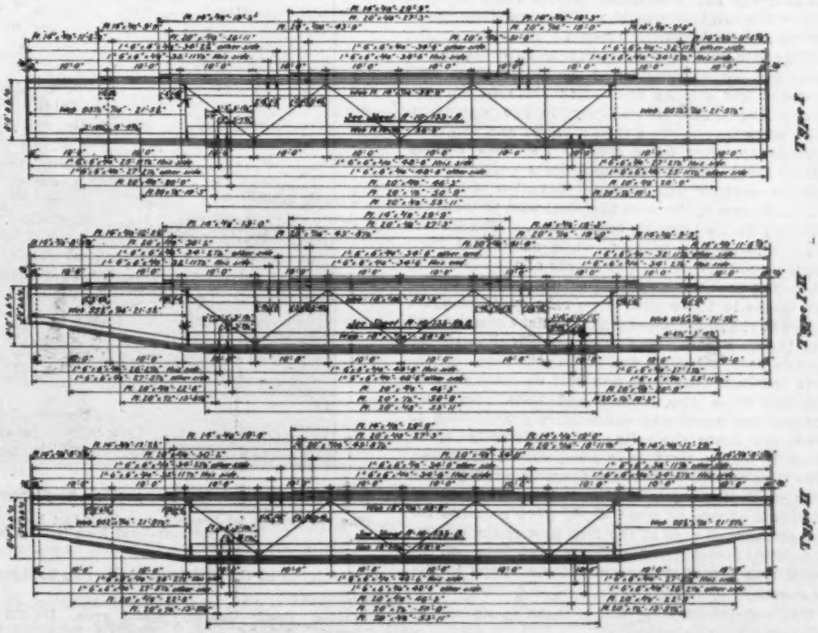


FIG. 2.—STANDARD TYPES OF 100-FT. DECK PLATE LATTICE GIRDERS, NO. PAC. RY.

girders and 100-ft. deck plate-lattice girders is indicated in Figs 1 and 2 herewith.

The most recently built plate-lattice girder bridge which the Northern Pacific has erected is that which crosses the Little Missouri River near Medora, No. Dakota, near the Montana boundary. Fig. 3 is reproduced from a photograph of this structure and is of especial interest from its showing the snow-covered bluffs in the background, with their peculiar formation, reminding one at once of the Bad Lands photographs which accompanied Mr. Starling's paper on the Mississippi floods, in our issue of April 22.

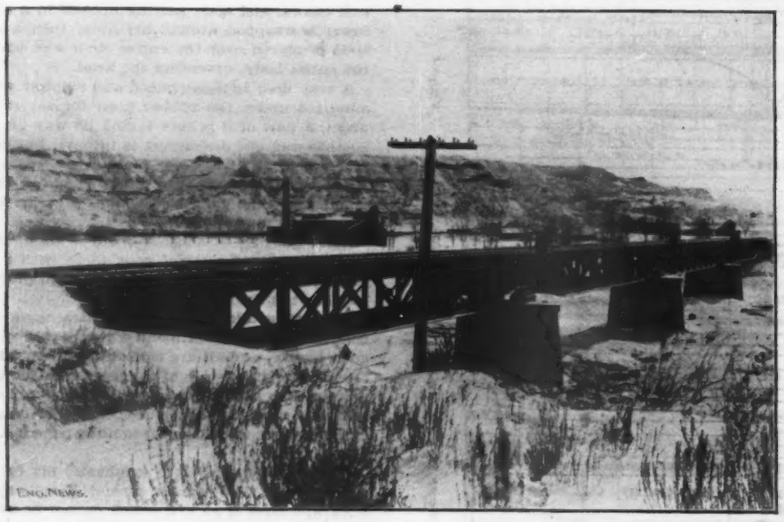


FIG. 3.—PLATE-LATTICE GIRDER BRIDGE OVER LITTLE MISSOURI RIVER, NEAR MEDORA, NO. DAK., NO. PAC. RY.

Designed by K. E. Hilgard, M. Am. Soc. C. E., Engineer of Bridges, No. Pac. Ry.; built by the Pencoyd Bridge & Construction Co., Pencoyd, Pa.

The girders for the Little Missouri bridge were completely riveted up in the shop and were shipped full length, each girder being loaded on three cars in a similar manner to the girders for the Lightning Creek bridge, which were shown last week.

The initial railway company, however, refused to ship the Little Missouri girders right side up, hence the original intention of setting these spans in place after riveting them up complete at the bridge site on cars was defeated. In order to obviate the double handling of the girders they were turned right side up and set in place on the masonry singly and successively in one operation. The cross frames were then inserted and the span riveted up, after being set in its final resting place. No special or falsework bents were required for the erection. The axis and elevation of base of rail of the new spans were identical with those of the existing Howe truss through spans. The girders were hoisted and lowered while suspended from timbers laid across the top chords of the old spans. Sufficient time wts available between the two passing trains to move girders on cars over the space between the new masonry piers, hoist them up, pull out the cars from under them, cut out the existing bridge floor, set down the girders on bearings, insert and temporarily fit and bolt up cross frames, lay new cross ties, which had been previously framed and numbered consecutively according to plan, put down the rails, and sufficiently spike them to let the next train pass, which, of course, was then carried by the new span. From 4½ hours (for the first span) to 3¾ hours (for last span), at intervals of two or three days, were required for the erection of each of the four new spans (exclusive of field riveting), during the week in which the track was transferred from the old spans to the new spans.

The substructure on which these spans rest is built of concrete throughout.

Figs. 4 and 5 illustrate the method of erection of the Little Missouri girders and with the above description will make it entirely clear to the reader.

A noticeable feature of the design of these girders is their reduced depth at the ends. This is occasionally objected to by some shops on account of the expense connected with bending the flange angles and cover plates, and their reaming in place, but it is believed to be fully justified by the increased safety with which large loads of timber, if occasionally displaced or shifted on cars, can pass in case of through bridges, and the increased stability against over-turning and the raising of bearings to the same elevation above high water as the bottom flange of the girder, in case of deck bridges.

Like the Lightning Creek bridge, which we illustrated last week, the Little Missouri bridge is built of soft steel with medium steel flange angles and cover plates with all rivet holes reamed, and is designed for 116-ton consolidation locomotives.

FIG. 4.—ERECTION OF LITTLE MISSOURI BRIDGE.

(The two girders for the last span have just been turned over and the cars withdrawn from under them. The girders are suspended from timbers laid across the top chords of the Howe trusses.)

The weights of the spans of these two bridges are as follows:

Lightning Creek Bridge, "special" shallow floor, 100 ft. through span.....	Entire span, 160,000 lbs., weight of one girder, length 102 ft. over all, 54,000 lbs.
Little Missouri River Bridge "Standard" 100 ft. deck span	Entire span, 120,000 lbs., weight of one girder, length 102 ft. over all, 50,000 lbs.

The average cost of the superstructures for the spans contracted for by the Northern Pacific Ry. Co. in 1895 was 3½ cts. per lb.; for those contracted for in 1896, the cost was slightly less than 3 cts. per lb., and the cost of those contracted for in 1897, on the basis of contracts recently let for the manufacture, will not exceed 2¾ cts. per lb. All the above prices include manufacture, freight charges, and either actual or estimated cost of erection; also framing, laying floor and painting. The contractors for the erection of these spans thus far built were Messrs. Kelly & Atkinson, of Chicago.

In order to secure uniformity in general design, details and strength, complete detail plans are furnished by the Northern Pacific Ry. Co. to the manufacturing bridge companies. As a rule most of these plans, as was the case with those furnished for the above-mentioned spans, after having been slightly revised or amplified in regard to rivet spacing, etc., are being used directly as working plans in the respective shops. The original standard plans of the railway company are made on tracing cloth, and are 24 ins. in width and vary in length. By being photographed they are reduced in width to that of an ordinary letter head. For the purpose of soliciting bids "per pound of shipping weight in finished superstructure," delivered f. o. b. cars St. Paul, blueprints made from the photographic negatives are submitted to the bidders, and the successful bidder only is furnished the necessary number of sets of blueprints made directly from the original tracings, after having secured the contract. The bulk of blueprints to be sent to all bidders is thus reduced to about one-fifth of that if made from the original tracings. The "photo-blueprints" (thus giving blue lines on white ground) are found to be exceedingly convenient for inspection and use in the office for detailing and estimating, and for a general supervision of the work in the shop and on erection. The saving effected in blueprint paper and postage, over the former practice of sending blueprints of full size standard plans for the solicitation of one single year's bridge crop, to each of about 16 bidders, equals, in most cases, almost the first cost of the photographic negatives. For every subsequent solicitation of bids on the same standard plans the economy becomes apparent, in a case where the bidders are to be furnished with complete detail plans for the various superstructures required.

It is believed that for a railway company requiring large quantities or numbers of superstructures annually the submitting of complete detail plans for the purpose of soliciting bids "per pound of shipping weight in finished structure," from the manufacturing bridge shops is the only reliable way of securing a close competition, which shall be equally fair to the railway company and the manufacturer. It is believed that only the elimination of every

uncertainty or doubt regarding the quality or kind or amount of work and the character of details required, as well as time allowed for execution, will result in placing every one of the competing companies on an equal footing, inasmuch as only too often smaller, less well-equipped or even less responsible bridge companies are being or have to be favored with concessions, after they have once secured the contract, as the lowest bidders—concessions which would never be made and never be asked for from better equipped, more conscientious and more reliable bridge manufacturers, who made their bids with the intention of complying strictly with the plans and specifications. It is further more believed that the more clearly defined and complete the specifications and the details shown on the plans are, the lower will be the average and lowest price on the same class and quality of work ultimately required and to be insisted upon by the railway company's engineer. This is still more important in the case where the railway company is not so disposed as to send one of their own permanently employed inspectors to the mill and shop, with whose requirements the bridge shop is beforehand familiar.

FIG. 5.—ERECTION OF LITTLE MISSOURI BRIDGE.

(Both girders have been lowered to their seats on the piers and the cross-frames are being swung into position previous to moving up the left-hand girder to the correct distance from its fellows.)

NOTES FROM THE ENGINEERING SCHOOLS.

University of Minnesota.—The College of Engineering and Mechanic Arts of this university has issued an "announcement" for the year 1897-98. We note that the college has instituted a special course for seniors in railway mechanical engineering. It is in charge of Assistant Professor H. Wade Hibbard, M. Am. Soc. M. E. In preparation for this specialty, after graduation from Brown University, he spent three years in the shops of the Rhode Island Locomotive Works. After a technical course at Cornell University he had experience in designing and testing for three years under the mechanical engineer of the Pennsylvania Railroad. During this time one summer was spent under salary in Europe, studying foreign locomotive engineering. He then became chief draftsman of the Lehigh Valley Ry. system, performing the duties of mechanical engineer in locomotive and car designing, shop machinery and other general railway work advisory to the Superintendent of Motive Power. He is a member of the American Railway Master Mechanics' Association, and was the chairman of the committee upon locomotive grates for burning anthracite coal, which was noticed editorially in our issue of June 24.

University of Virginia.—This university is offering a number of summer courses of study, two of them being in mathematics and engineering. The work will be arranged to suit the special needs of the student, and will be mainly individual in its character. The instruction will be suitable for two classes of students: 1. Those who desire to perfect their preparation for entering the regular classes in pure and applied mathematics at this or other universities and colleges. 2. Those who desire to carry their mathematical studies beyond the usual limits of the undergraduate course. Each course will extend over six weeks from July 1, and will include five lessons per week.

Lehigh University.—A list of subjects for theses presented by candidates for degrees in the class just graduated has been published. The number of candidates for the different engineering degrees is as follows: Engineering mines, 2; civil engineer, 22; mechanical engineer, 23; bachelor of science (in metallurgy), 8; bachelor of science (in mining), 2; electrical engineer, 24. We note that of the 22 candidates for the degree of C. E., seven presented theses relating to water supply, sewerage, water filtration or sewage filtration.

THE MINERAL PRODUCTS OF THE UNITED STATES—1887 TO 1896, INCLUSIVE.

David T. Day, Chief of the Division of Mineral Resources, U. S. Geological Survey, has issued a sheet showing the quantity and value of the mineral products of the United States for each year from 1887 to 1896, inclusive. From this sheet the accompanying table of some of the chief items is prepared, taking only the

Products.	1887 Quantity.	1887 Value.	1896 Quantity.	1896 Value.
Pig iron ..... long tons.	6,417,148	$121,925,800	8,623,127	$90,250,000
Silver, coining value ..... ozs.	41,269,240	53,350,000	58,814,909	76,069,236
Gold, coining value ..... "	1,500,500	33,000,000	2,508,132	53,098,000
Copper, value at New York ..... lbs.	185,227,331	21,115,916	455,097,139	48,686,207
Lead, value at New York ..... short ton.	145,700	13,113,000	187,000	10,472,000
Zinc, value at New York ..... " "	50,340	4,782,300	81,499	6,519,920
Quicksilver, value at San Francisco ..... flasks.	33,825	1,429,000	30,765	1,075,449
Aluminum, value at Pittsburg ..... lbs.	18,000	59,000	1,300,000	520,000
Antimony, value at San Francisco ..... short tons.	75	15,000	601	84,290
Nickel, value at Philadelphia ..... lbs.	205,566	133,200	17,170	4,464
Coal—Bituminous ..... short tons.	87,887,360	96,004,656	137,040,276	114,801,515
" —Pennsylvania anthracite ..... long "	37,578,747	84,552,181	48,010,616	81,415,785
Building stone	.....	25,000,000	.....	31,346,171
Petroleum ..... bbls.	28,276,866	18,877,094	60,960,361	58,518,709
Natural gas	.....	15,817,500	.....	12,450,260
Cement ..... bbls.	6,002,744	5,074,377	9,479,473	6,378,385
Phosphate rock ..... long tons.	480,558	1,836,818	948,720	2,868,934
Salt ..... bbls.	7,831,962	4,093,846	13,850,726	4,040,829
Total value non-metallic products	.....	$270,989,420	.....	$334,187,373
" " metallic products	.....	248,925,054	.....	286,782,570
Estimated value unspecified minerals	.....	800,000	.....	1,000,000
Total	.....	$520,714,474	.....	$621,969,943

In our issue of June 10 is a much more detailed statement of the mineral production for 1895-6, as compiled by "The Engineering and Mining Journal" for its annual publication, "Mineral Industry." The condensed statement here presented is chiefly interesting as exhibiting the advance made in mineral production throughout the United States in the last ten years. The fuller sheet from which this is taken shows the annual fluctuations in quantity and value within these ten years; but it may be said that as a rule the figures given for 1887 are very near the minimum for each product, and those of 1896 are close to the maximum in each case. In other words, the advance in product quantity has been a generally steady one; but the unit value has fluctuated, with a generally downward tendency.

BOOK REVIEWS.

THE GAS AND OIL ENGINE.—By Dugald Clerk, Assoc. M. Inst. C. E., F. C. S., etc. Sixth edition. New York: John Wiley & Sons. Cloth; 8vo.; pp. 558. $4.

The first part of this volume includes Mr. Clark's original treatise on the gas engine, first published about ten years ago, and which has since remained one of the standard works on the subject. The second part, which occupies about half of the book, discusses gas engines produced since 1886, and oil engines. An appendix contains a list of British gas and oil engine patents from 1791 to 1893 inclusive, with some useful tables of analysis, etc. The second part fully sustains the author's reputation as the leading English writer on the subject. His method of treatment is full, clear and logical, and the book should find a place in the library of every engineer and student who desires to be well informed concerning gas and oil engines.

ALUMINUM AND ALUMINUM ALLOYS.—The Pittsburg Reduction Co., Pittsburg, Pa. Cloth; 6½x4¼ ins.; pp. 206. $1.50.

This handy little book, edited by Mr. Alfred E. Hunt, S. B., M. Am. Soc. C. E., President of the Pittsburg Reduction Co., contains more practical information about aluminum, its properties and its uses in the arts, than any other book of which we have any knowledge. It is to some extent, of course, an advertisement and catalogue of the goods of the company, but it is chiefly a compilation of all the scientific and practical data known upon the subject of aluminum. The book also contains tables of weights and measures, areas of circles and other like matter usually found in engineers' "pocket books," some of which, such as a table of heat units, seems to have no relation to aluminum, but this only widens the field of usefulness of the book. An interesting bit of information is that the Pittsburg Reduction Co. has an arrangement with the Carnegie Steel Co. by which any of the sections in which steel is now rolled can be furnished in aluminum whenever the size of the order is sufficient to warrant the putting in of rolls for the purpose. As the price of aluminum of a given section is now about the same per foot of length as copper of the same section, or about ten times that of steel, its use in constructive arts is likely to increase greatly in the near future.

THE ENTROPY-TEMPERATURE ANALYSIS OF STEAM ENGINE EFFICIENCIES.—With a Blank Diagram Arranged for Easy Application to Any Concrete Case. Prepared by Sidney A. Reeve, M. E., Adjunct Professor of Steam Engineering at the Worcester Polytechnic Institute. Progressive Age Publishing Co. Cloth; 8vo.; pp. 20; with folded diagram. 75 cents.

"What is entropy?" was a question once asked of a celebrated physicist, to which he replied: "Entropy is a very bad name for it." If we try to find the answer in the book before us we find one that is equally unsatisfactory, viz.: "While we may not be able to imagine or exactly express to ourselves just what, in a physical sense, is

entropy, yet that need be no reason why we may not employ it mathematically for many a useful purpose." It may also be defined, for the information of those of our readers who have not hitherto made its acquaintance, as an imaginary mathematical something with which students of thermodynamics must wrestle and which they must use as the student of strength of materials uses a differential or a moment of inertia whether he can form a mental conception of its entity, if it has any, or not. A more scientific definition is: If in a diagram of the work done by a heat engine the area represents energy and the ordinates absolute temperature, the corresponding abscissas represent entropy; or entropy is the quotient of the energy divided by the absolute temperature. For many years students in engineering colleges who take a course in thermodynamics have been required to do something with entropy, and perhaps one in a thousand may have used it in his researches in steam or gas engines after graduation, while the rest have forgotten all about it. There has recently, however, been a renaissance of entropy literature, especially in England, and future students may be required to become familiar with it. Prof. Reeve's little work puts the subject in its simplest form, no mathematics other than a few algebraic equations being used, and his diagram is another step towards making entropy of some practical use. We quote the following from his preface:

The blank submitted herewith has been prepared in the hope of more widely introducing to steam engineers this prettiest of methods for analyzing heat-engine efficiencies. The entropy method has probably not received more general attention and favor because of the labor involved in preparing for each analysis the pre-requisite curves. In the accompanying blank this work has been done once for all. While no satisfactory determination of hidden truth can ever be accomplished without trouble, the entropy method, once understood, will be found to reveal with surprising speed and facility factors in engine economy hitherto only to be estimated, at best, and that only at the expenditure of tedious labor.

A HANDBOOK ON MODERN EXPLOSIVES.—A practical treatise on the manufacture and use of dynamite, gun-cotton, nitro-glycerine and other explosive compounds, including collodion-cotton, with chapters on explosives in practical application. By M. Eissler, Mining Engineer and Metallurgical Chemist, author of "The Metallurgy of Gold," "The Metallurgy of Silver," etc. Second edition, enlarged, with 150 illustrations. London: Crosby, Lockwood & Son; New York: D. Van Nostrand Co. Cloth; 7½ × 5 ins.; 406 pp.; illustrated. $5.

The first edition of this work appeared in 1889, following a former work by the same author, published by John Wiley & Sons in 1884, and entitled "The Modern High Explosives," claimed to be the first English treatise upon this subject. This second edition is larger than that of 1889 by about 100 pages of text, and it includes an entirely new chapter on the practical application of nitro-gelatine and gelatine dynamite. The author defines the characteristics of modern explosives, details the history of attempts to find substitutes for gunpowder, and describes the properties and processes of manufacture and application of nitro-glycerine, dynamite, gun-cotton, collodion-cotton and other explosive compounds. He describes the means of determining the relative strengths of these explosives and the characteristics which modern explosives should possess. He then devotes several chapters to their practical application in firing mines, rock-blasting, tunnelling, shaft sinking, in submarine engineering and in the removal of stumps, boulders, piles, etc. An appendix contains the "Analysis of Explosives," by Capt. Philip Hess, of the Austrian Army; the testing of dynamite, etc., by Col. V. D. Majendie, the Chief Inspector of Explosives for England, and the English "Explosives Act" of 1875.

A TEXT-BOOK ON ROOFS AND BRIDGES, PART II., GRAPHIC STATICS.—By Mansfield Merriman, Professor of Civil Engineering in Lehigh University, and Henry S. Jacoby, Associate Professor of Civil Engineering in Cornell University. Third edition, enlarged. New York: John Wiley & Sons. 9½ × 6 ins.; cloth; 234 pp.; diagrams. $2.50.

In this edition the blank leaves have been omitted, with a corresponding reduction in comparatively useless bulk; but the text proper has been extended to nearly double the former length. Chapters II. and III. have been rewritten in part, and Chapters V, VI and VII. are entirely new. Chapter V. discusses trusses with broken chords, Chapter VI. takes up the computation of miscellaneous trusses, including the Pegram, Petit and Baltimore trusses, unsymmetrical trusses, double and quadruple systems of the Warren and Whipple type, and the Greiner truss, introduced on the B. & O. R. R. in 1894 for overhead highway purposes. In the same chapter the authors discuss the horizontal shear in a beam, roof trusses with counter braces, the Ferris wheel with tensile spokes, and the bicycle wheel with tensile spokes. Chapter VII. is devoted to the elastic deformation of trusses, under maximum load and locomotive wheel loads.

A MODEL MACADAM ROAD is being built at New Brunswick, N. J., by the Road Bureau of the U. S. Agricultural Department. Through the efforts of Prof. E. B. Voorhees, of the New Jersey Experimental Station, at New Brunswick, two government experts have been sent to supervise the construction and to bring with them the most approved machinery. The street treated is College Ave., in the residential part of the city. The trap rock is crushed upon the ground, spread by an improved distributing wagon and laid to a depth of 4 ins. It is then rolled by a heavy steam roller and treated with a covering of cinders and a final coat of screenings. When this is completed, a 600-ft. length of "farmers' cheap macadam" road is to be built. This road will be 8 ft. wide and 5 ins. deep. Road engineers and freeholders from various parts of New Jersey are closely watching the methods of construction.

A WEEKLY CANADIAN STEAMSHIP LINE between Canada and Liverpool is being developed. The necessary capital has been subscribed in England, and a ten-year contract has been awarded to Petersen, Tate & Co., of Newcastle-on-Tyne. The Canadian government grants an annual subsidy of $505,000, and the British government gives $225,000 per year, for the service. There are to be four steamers of 10,000 gross tons register each, and 525 feet long, with a draft not exceeding 25 ft. 6 ins. These ships are each to carry not less than 300 first-class, 200 second-class and 800 steerage passengers, and from 1,500 to 2,000 tons of freight. They must make the trip across the Atlantic at an average speed of 500 knots in every 24 hours, or nearly 21 knots per hour. These steamers will carry the English and Canadian mails between Liverpool and Quebec or Montreal in summer, and St. John's or Halifax in winter. It is said that the steamers will be built under the supervision of the English Admiralty, and arranged to be fitted as cruisers in case of a maritime war. Sir Sandford Fleming, formerly Chief Engineer of the government railways of Canada, contends that a 20-knot navigation is impracticable, or at least extremely dangerous, in the fogs, icebergs and submerged ice of the St. Lawrence and its approaches. The distance from Montreal to Quebec is 170 miles, partly through dredged channels; and below Quebec to the mouth of the St. Lawrence are 200 miles of islands and irregular currents.

THE KITE-AIRSHIP, invented by Mr. Charles H. Lamson, of Portland, Me., has demonstrated its ability to lift a man 50 ft. from the ground and to keep him in the air for fully half an hour. The kite used by Mr. Lamson was a double one of the Hargrave cellular type, weighing about 100 lbs. While this kite has proved to the satisfaction of Mr. Lamson and his assistant, Frederick Bickford, that it could support the weight of a man at the height of 1,000 ft. in the air, the kite was stopped at 50 ft. elevation by an attached cord. Mr. Lamson now proposes to add to the kite an appliance by which the man suspended from the two box kites can raise or lower these kites at will by manipulating the bowsprit and forward sail. The Lamson-Hargrave kites are now being used at the Blue Hill (Mass.) meteorological station, under an appropriation by Congress, to obtain temperature, direction of air currents, etc., at heights of 1,000 ft.

A SAMPLE WAREHOUSE for the exhibition of American goods, is being organized at Caracas, Venezuela, under the auspices of the National Association of Manufacturers of the United States of America. The preliminary arrangements are completed and a considerable portion of the available space has already been engaged by prominent manufacturers. The warehouse is being established under a special concession granted by the government of Venezuela, by which goods for exhibition are entered free of duty and other privileges afforded. A pamphlet is issued by the Association giving views and plans of the exhibition building and full rules, regulations and charges for space. This pamphlet can be secured by addressing Mr. Theodore C. Search, President of the National Association, at the general office, 1751 N. Fourth St., Philadelphia, Pa.

NEW FORESTRY REGULATIONS for U. S. reservations have been submitted to the Secretary of the Interior by Commissioner Hermann. Forest fires and their prevention are largely dealt with; prospecting, locating and developing minerals on these lands are permitted; provision is made for the use of the lands for school houses, churches and for water supply for domestic mining, milling and irrigation purposes; wagon roads may be built through the reserve and right of way obtained for irrigating canals, flumes and reservoirs; live stock may be there pastured, except sheep, which injure growing forest cover in regions of limited rainfall. Provision is made for the exchange of land by parties having bona-fide claims upon land within the reserves; mineral lands in the reserves are made subject to location and entry under the mining laws in the usual manner, and owners of mining claims may fell and remove timber on their claims. Bona-fide settlers may use timber freely for needed purposes, but this privilege applies only to those who have not sufficient timber on their own claims. Sales of timber will be permitted in limited quantities; but to avoid monopolies the department may, when the sales exceed $500, allot the quantity to several bidders. Unlawful cutting of timber and other depredations must be closely watched for.

THE ELECTRICALLY OPERATED DRAW of the new bridge connecting Duluth, Minn., and Superior, Wis., claims attention as another interesting application of electricity to bridge work. The draw has a length of 500 ft., a width of 58 ft., and weighs 2,000 tons. It can with the present equipment be turned through an angle of 90° in less than two minutes. As the bridge is used for both steam and electric railways, considerable weight comes on the ends at times and must therefore be firmly supported upon the end piers when closed. Also the rails must be lifted before opening and the latch operated. These three functions are performed by two General Electric 1,200 motors, one placed at each end. The swinging of the draw is performed by two General Electric 200 motors, operating through a duplicate set of reduction gearing. This plan was adopted to avoid a shut down at any time, due to an accident to any part of the driving mechanism. All the operating devices are controlled from a cab placed above the roadway in the center of the span from which an uninterrupted view can be obtained in all directions. The operator has within easy reach the series parallel controllers, cutouts, switches and Weston ammeter and voltmeter. Suitable switches are provided to substitute resistance for either of the driving motors. A telltale is also placed in the cab to indicate when the bridge is correctly closed and ready for trains. The machinery for this bridge was built from special designs of Mr. W. T. Sears.

THE COPPER PRODUCTION OF THE WORLD for 1896 is thus given in "Le Genie Civile:"

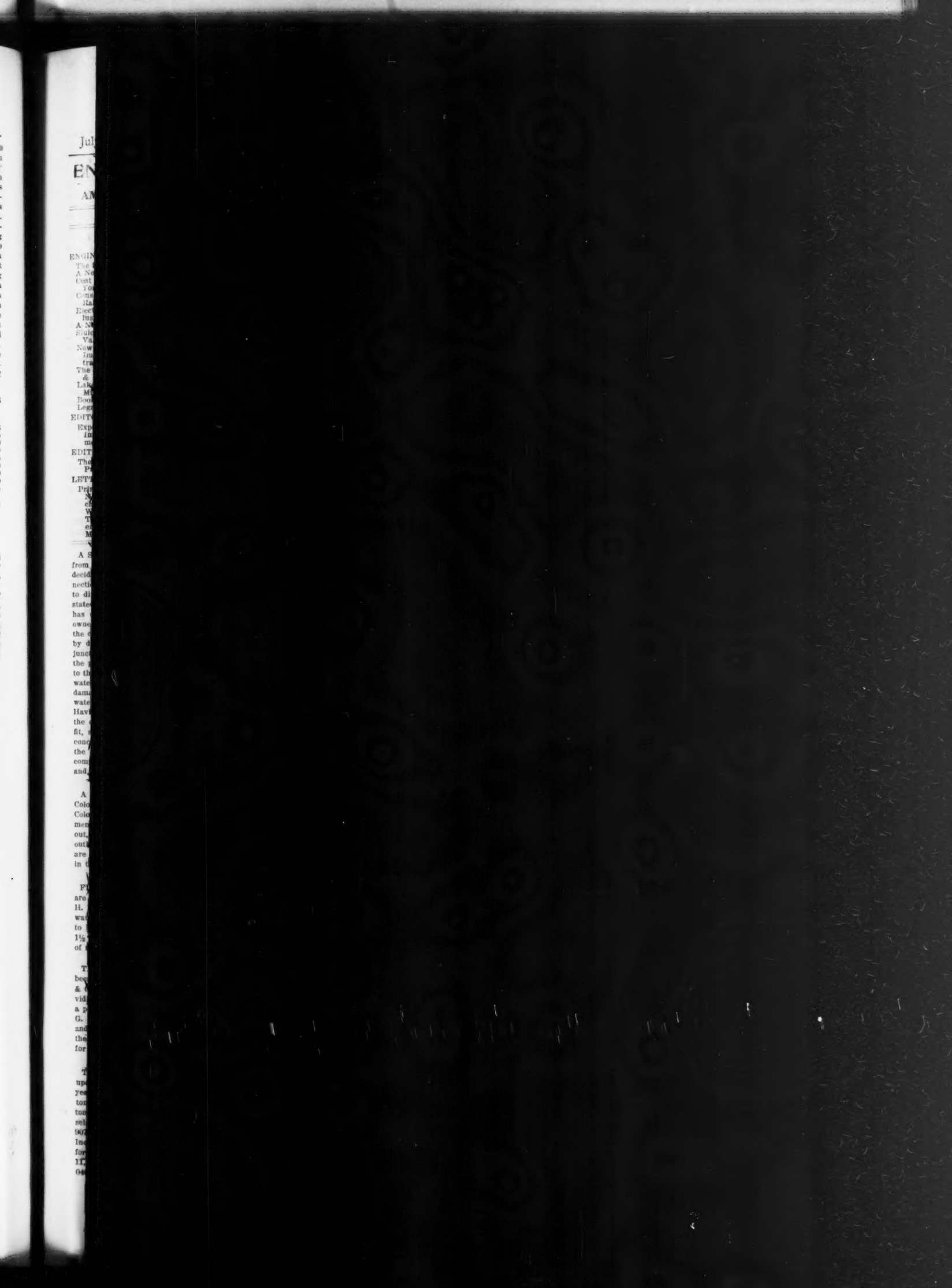
Country.	Metric tons.
United States	203,893
Spain and Portugal	53,575
Chili	25,500
Japan	21,000
Germany	20,085
Mexico	11,150
Australia	11,000
South Africa	7,450
Other countries	21,825
Totals	373,208

In 1888 the total copper production was 258,036 tons; in 1890 it was 310,472; 1893, 303,534; 1894, 324,505; and in 1895 it was 334,285 metric tons.

BURNING CORN FOR FUEL has often been mentioned by political orators as one of the signs that the poor farmer who burns it is in the last ditch of poverty, but a bulletin issued by the Experiment Station of the University of Nebraska, giving results of tests of the value of corn as fuel shows that the burning of corn may be a proceeding showing financial wisdom and one greatly to the farmer's benefit when the price of corn is low and that of coal high. The tests showed that 1 lb. of screened Wyoming coal, costing $6.65 per ton, evaporated 1.9 times as much water in a steam boiler as could be evaporated by 1 lb. of a good grade of yellow dent corn on the ear, not thoroughly dry. The following figures show the value of corn per bushel as fuel when coal of the same variety as that used in the tests is selling at the prices given:

Coal per ton	$4.87	$5.41	$5.95	$6.49	$7.11	$7.57	$8.11
Corn per bushel	9	10	11	12	13	14	15

THE CALORIFIC VALUE OF BAGASSE has recently been determined at the Ohio State University, and we are indebted to Prof. W. T. Magruder, Professor of Mechanical Engineering in that institution, for the following results of tests. Bagasse is the ground sugar cane, which is used by the sugar mills as fuel under steam boilers. The samples came from the Glenwild Sugar Factory, Berwick, La., and the tests were made with the Mahler calorimeter by Mr. Frank Haas, of the Chemical Department of the University. The moisture found in two samples, after drying to constant weight, was 44.13 and 44.38%, average 44.26%. The heating value of the dry bagasse, in three tests, was 4,542, 4,541 and 4,476 calories, or an average of 4,520 calories per lb., or 8,136 British thermal units per lb. This is equivalent to 4,535 B. T. U. for the moist bagasse containing 44.26% moisture.

A TRAIN WAS DERAILED on the Lehigh Valley R. R. July 10, just south of Ithaca, N. Y. A locked switch appears to have been the cause. No injuries are reported, and the damage done was slight.

INDIAN INK, or encre de Chine, as it is more correctly called, says the English Consul at Wuku, China, is made as follows: The chief material used is pure colza oil, or the oil expressed from the poisonous seeds of a tree extensively cultivated in China and Japan. To this oil varnish and pork fat are added, and the lampblack produced by the combustion of these materials is classed according to the materials and grade of fineness and time of combustion. The paste made from this lampblack has some glue added and it then beaten on wooden anvils with steel hammers, into masses weighing about half a pound each. A certain quantity of musk, or Baroos camphor is added for scenting and sometimes gold leaf is used to give it a metalic lustre. This material is then molded in carved wooden molds, dried for about 20 days and then gilded. The price in China ranges from less than 50 cts. to $35 per pound, in the dozen or more different grades manufactured. This ink is only made in the Anhui Province of China, and in 1895 about two tons of it, valued at $2,820, were exported from Shanghai.